




JOINT HIGHWAY RESEARCH PROJECT

JHRP-77-20

AN INVESTIGATION OF THE FINAL
CONSTRUCTION CONTRACT PAYMENT
PROCEDURE FOR THE INDIANA STATE
HIGHWAY COMMISSION

David L. Mays





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Final Report

AN INVESTIGATION OF THE FINAL CONSTRUCTION CONTRACT
PAYMENT PROCEDURE FOR THE INDIANA STATE HIGHWAY COMMISSION

TO: J. F. McLaughlin, Director
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FROM: H. L. Michael, Associate Director
Joint Highway Research Project

November 8, 1977

Project: C-36-67I

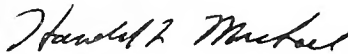
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Attached is the Final Report on the approved JHRP Study titled "An Investigation of the Final Construction Contract Payment Procedure for the Indiana State Highway Commission". The title of the Report is the same. Mr. David L. Mays, Graduate Instructor in Research on our staff, has authored the report and conducted the Study under the direction of Professor Donn Hancher.

The Study objectives of determining the existence of any problems with the procedures and the causes and possible remedies of any problems were achieved. A number of recommendations are included which should be beneficial to ISHC and the State of Indiana. One of these benefits should be a decrease in interest penalties.

The findings have been presented to the management of the ISHC Construction Division for discussion prior to finalization of this report. Comments received were considered in preparation of this final document.

Respectfully submitted,



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PAYMENT PROCEDURE FOR THE INDIANA STATE HIGHWAY COMMISSION

by

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Joint Highway Research Project

Project No.: C-36-67I

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He would also like to express his gratitude to his major professor, Dr. Donn E. Hancher, for the assistance in selecting a research topic and its funding, and for his guidance and encouragement throughout both the research and the author's Master's degree coursework.

Finally, the author would like to thank all of the Indiana State Highway Commission personnel who provided him with an ample amount of data and suggestions about the research topic.

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ABSTRACT

Mays, David Lynn. MSCE, Purdue University, December 1977. An Investigation of the Final Construction Contract Payment Procedure for the Indiana State Highway Commission. Major Professor: Dr. Donn E. Hancher.

Prior to March 1972, several contractors who performed highway related construction work for the State of Indiana complained about the State's slowness in making final retainage payments. These complaints resulted in a law being passed by the Indiana General Assembly which required the State of Indiana to pay an interest penalty to the contractor if the final payment was not made within 180 days of contract acceptance. Indiana State Highway Commission (ISHC) officials believed that this law would benefit the contractor through faster retainage payments, and at the same time motivate its project engineers to submit all of the required paperwork for their completed projects so that this 180 day target date could be met. However, it was quickly discovered that this law did not accomplish these objectives. In every year since interest penalties began occurring, the total amount of interest penalties paid to the contractor has increased. Therefore, ISHC officials felt that research was needed in order to determine how severe the interest penalty problem had become and why the interest penalties continue to occur. The ISHC officials also suggested that the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge,

Maintenance, and Traffic Contracts might be a cause of interest penalties in that its up-to-dateness and clarity are sometimes questioned.

In order to answer these questions, the researchers first had to determine the components of the final construction contract payment procedure and who participated in each. This was accomplished by interviewing three types of ISHC personnel-- District Review Officers, project engineers, and personnel at the Division of Materials and Tests. Each group provided suggestions on how to improve the procedure and expressed opinions on why the present problems exist. The use of the Construction Record was also investigated in the interviews with District Review Officers and project engineers. Finally, the severity of the interest penalty problem was determined by a computer analysis of contract data from 1972 through August 31, 1977.

The research showed that the interest penalty problem is caused primarily by the project engineers and the Division of Materials and Tests' personnel. The project engineers have been turning in the required documentation (the Construction Record) late in the 180 day time period which gives the members of the later components of the procedure less time to complete their duties. The Division of Materials and Tests has had trouble issuing its material certification within the 180 day limit due to organizational problems. The computer analysis showed that interest penalties steadily climbed from \$0.00 in 1972 to a projected \$43,789.86 in 1977.

Finally, the research produced several recommendations to improve the final construction contract payment procedure and thereby decrease interest penalties. Improvements to the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts are also proposed as a result of the research.

CHAPTER 1

INTRODUCTION

From the contractor's point of view, the most important aspect of a construction job is being paid what is due him by the owner. Prior to March 1972, several of the contractors in Indiana who performed work for the State felt that the State was much too slow on the final retainage payment. Their opinions prompted the Indiana legislature to pass a law requiring the State to pay the contractor a penalty if final retainage payment was not carried out within a certain period of time after contract acceptance. In the years following the enactment of this law, State highway officials have noticed that they are still having trouble paying the contracts on time and this problem has gotten worse each of the last three years in terms of total penalty dollars. It was then decided that a review of the final construction contract payment procedure was needed in order to point out those areas which are causing the penalty payment problems. Therefore, it is the purpose of this paper to investigate the present contract payment procedure and to propose to the Indiana State Highway Commission changes in the procedure that will increase its efficiency, along with decreasing the amount of money that the State has to pay to contractors each year in penalties for late final retainage payments.

1.1 Justification for the Study

An underlying purpose of every local, state, and national governmental agency is to perform its assigned functions at the lowest possible price while at the same time getting the highest quality work possible. The Indiana State Highway Commission strives to accomplish the goal behind this policy but it sometimes runs into problem areas. At present, the final construction contract payment procedure is such a problem area. To justify this statement, a short history of the problem will be presented which should help to prove the need for a study of this aspect of the Indiana State Highway Commission's activities.

The State of Indiana utilizes the Unit Price Contract system for most of its highway work. This system is excellent for both heavy construction and highway construction because of its flexibility. In highway construction, it is very difficult to determine in advance the exact quantities of work to be accomplished by the contract, such as the amount of excavation or fill required. Unexpected situations can develop throughout a project that can change the estimated quantities. The Unit Price Contract centers around these estimated quantities. The owner of the project (the State of Indiana in our case) makes an estimate of the quantities of work for each activity or work item of a given job. These estimates are in terms of units of work which correspond to the type of activity, such as cubic yards for backfill. The contractors who desire to perform the work for the State of Indiana then submit a bid in terms of a price per unit of work. This unit price includes the estimated costs of the

material, labor, and equipment needed for the activity plus the profit and overhead for the contractor. This way of contracting in terms of units of work allows for easy calculation of additions to or subtractions from the estimated quantity of work for each job activity.

The overall Unit Price Contract system for the State of Indiana follows a certain procedure. After the bids have been received from the contractors, the unit prices of each bid are checked by a computer for gross variation from the norm and unbalancing of the bid. The contract is awarded to the lowest qualified bidder. Work begins and as it progresses, the contractor is entitled to periodic payments for work already completed. The project engineer of the contract estimates how many units of each work item have been completed by the contractor during the payment period. These quantities are multiplied by the unit price of each and are summed to arrive at the allowable progress payment. However, a portion of this progress payment, usually 5-10 per cent, is retained by the State of Indiana to protect it from poor work, contract violations by the contractor, minor claims for materials, and other contract related problems. This progress payment procedure is repeated throughout the duration of the project.

When the contractor completes his contractual work and an Indiana State Highway Commission official gives it a favorable inspection, the contractor is relieved of further maintenance and the project engineer is required to prepare a final estimate of both quantities and costs for the project. The State of Indiana then follows its final construction contract payment procedure to determine

the final dollar amount due the contractor, including the money retained during each progress payment period. This procedure will be discussed later in detail but it will suffice to say here that it includes the checking by the District Review Officer of the project documents as computed and compiled by the project engineer, material certifications for all materials required by the contract by both the District Office Materials' Laboratory and the Division of Materials and Tests, and the contractor's agreement that the final quantities are what he put in place. This final dollar amount due the contractor can change from that expected based on the initial contract amount. The final amount the contractor receives can decrease due to liquidated damages where a contractor completes the contract late, actual quantities in place being lower than those originally estimated, or mistakes in the State's favor on prior progress payments. Conversely, the final amount the contractor receives can be an increase over what was originally estimated due to actual quantities in place being higher than originally estimated, extra work items, mistakes in the contractor's favor on prior progress payments, or penalties levied against the State because it did not complete its final construction contract payment procedure on time. This last item provides the basis for this study.

Prior to March 1972, several contractors who performed work for the State complained that it was taking an unreasonable and costly length of time for them to receive their final payment from the State of Indiana for a contract including the money retained. This prompted the 1972 Session of the Indiana General Assembly to change

the statutes existing at that time pertaining to the final contract payment on highway related construction contracts performed in Indiana. This new law is found in the Transportation and Public Utilities division of the statutes (8-13-5) and the pertinent quote is in Chapter 5, Section 7 and is as follows:

"Each contract entered into pursuant to the provisions of this chapter shall provide for final payment within one hundred eighty (180) days after acceptance of the project; provided that final payment shall not be so made as to any amount which is in dispute or the subject of a pending claim; and provided further that final payment shall be so made as to that portion of a contract or those amounts which are not in dispute or the subject of a pending claim, and such partial payment shall not constitute any bar, admission, estoppel or have any other effect as to those payments in dispute or the subject of a pending claim. For each day after one hundred eighty (180) days, or thirty (30) days after settlement of a claim, the commission shall pay to the contractor a penalty for late payment of money due to the contractor. This penalty shall be computed at the rate of interest of six per cent (6%) per annum on the unpaid balance."

This change in statutes also specifies that this penalty clause is applicable to all highway related construction contracts for which bids were received by the State of Indiana on or after March 1, 1972.

On August 10, 1972, N. W. Steinkamp, the Chief Highway Engineer for the State of Indiana at the time, issued General Letter No. 2-73 which contained a supplemental specification for contracts which discusses the new statute and points out the beginning and ending days of this contract payment procedure period in order to compute possible penalties. This specification is stated as follows:

"Except as otherwise provided herein, final payment will be made to the contractor within 180 days after acceptance of the project. Acceptance shall be considered as the date the contractor is relieved of further maintenance as provided in 107.16 and set out in the final acceptance letter.

If final payment is not made within 180 days of final acceptance, the contractor will be paid interest in the amount of 6% per annum on the unpaid balance or retainage, subject to the following conditions:

The final date for computation of interest will be the date that the final estimate is prepared in the Central Office and mailed to the contractor for his signature.

Interest will not be paid for those days that delay in payment of the final estimate is not directly attributable to the State. Included in this category, but not limited thereto, is the elapsed time used by the contractor to review and approve the final pay quantities, proof of payment of railroad indebtedness, delinquent or supplemental payrolls or material records, or any other reason that is controlling to the final payment and beyond control of the engineer.

Funds retained for claims, or resulting from litigation, or amounts in dispute will not be eligible for payment of interest until 30 days after settlement."

The new statute quoted previously was intended to benefit both the contractors and the State of Indiana. By having this type of law, the contractor is assured either of receiving the final amount due him within 180 days of contract acceptance or of acquiring a larger dollar amount after the 180 day deadline due to an interest penalty having to be paid by the State of Indiana. The State of Indiana is benefited in that its personnel know that they have only 180 days to complete the final construction contract payment procedure without penalty. This type of regimen provides for stricter compliance with the law since a disregard for the time limit would cause an unanticipated outlay of funds by the State.

However, it was discovered that the existence of this new statute did not compel the State of Indiana to pay the final amount due the contractor within 180 days of contract acceptance on all of its construction contracts. In fact, contract data shows that the State

of Indiana is getting worse in this respect each year. This can be seen on Table 1 shown below:

TABLE 1

CONTRACT DATA COMPARISON

<u>Year</u>	<u>Total Penalty Amount Paid During the Year</u>	<u>Percentage of Contracts in Which Penalties Were Paid</u>
1974	\$ 1,327.22	1%
1975	\$17,417.43	14%
1976	\$32,272.57	21%

It can easily be seen that both sets of data are increasing, even though a law is in effect that tries to prevent this.

Therefore, Indiana State Highway Commission officials realized that they still have a problem with the final construction contract payment procedure. This topic surfaced when an advisory committee of both Indiana State Highway Commission officials and Purdue University Civil Engineering personnel met in the Fall of 1976 to discuss possible research topics. It was felt that due to the illustrated data, it would be worth the time and money required to investigate the present construction contract payment procedure and to determine possible problem areas and their solutions. The goal of the State of Indiana is to pay all of its construction contracts within the 180 day allotted time period. It is hoped that through the construction contract payment procedure study of which this paper is a summary, this goal will be closer to realization.

1.2 Objectives of the Study

There are three primary objectives to this investigation. All relate to one another and lead to the same result-- a more efficient final construction contract payment procedure. Each will be discussed separately and indications given of its importance to this study.

The first objective is that of investigating the actual final construction contract payment procedure and how it is carried out. How this procedure is supposed to be accomplished will be discussed in Chapter 2 of this paper. However, it should be pointed out that the present procedure makes strong use of the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. Indiana State Highway Commission officials have expressed the opinion that the way the present construction contract payment procedure is being carried out by State personnel might be causing penalties having to be paid on construction contracts. They feel that there could be inefficiencies in the present system, which when discovered and alleviated, could enable the State of Indiana to complete a higher percentage of its final construction contract payments within the 180 day time limit. This would then result in a smaller total penalty amount being paid by the State of Indiana to contractors during the year. Therefore, a thorough investigation of this final construction contract payment procedure is of utmost importance to this study.

The second objective of this investigation is a complete review of the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. As can

be seen from the title, it has been seven years since this publication has been updated. This guide is used by the project engineer of each contract to complete the paperwork required for the highway related construction project. It offers to the project engineer a format of computing final pay quantities for each project work item. As was expressed with the final construction contract payment procedure, Indiana State Highway Commission officials feel that this guide could be inhibiting the payment procedure process and could in turn be a primary reason for interest penalties having to be paid to the contractors. Complaints have been expressed also by both project engineers and District Review Officers with respect to inefficiencies caused by this book. Therefore, the content of this guide will be completely researched and will be discussed at length with Indiana State Highway Commission officials around the State of Indiana.

The third and final objective of this study is that of completing a data analysis of all highway related construction contract data since the interest penalty statute was enacted by the Indiana General Assembly in 1972. Contract data is available from the Indiana State Highway Commission Indianapolis office on computer printouts beginning in 1972. Contract data is updated each month as to those contracts still in progress at the end of the month along with those contracts that were completed during the month. A sample of the type of contract data available from the State of Indiana can be seen in the Computer Program Development section (7.1) of this paper. The objective of the data analysis is to point out the problem areas of the final construction contract payment procedure with respect to contract type,

project engineer type, geographic district, and the reasons for the interest penalties. From the compiled data, several graphs and tables will be made to show interest penalty trends. An example of this has already been seen in Table 1 in the Justification for the Study section (1.1) of this paper. This table pointed out that the penalty situation has gotten worse in each of the last three years in the State of Indiana. Therefore, it is hoped that this data analysis will illustrate that there is a construction contract payment procedure problem and where the problem is most critical. Finally, it should be pointed out that this data analysis will include all contract data from 1972 through August 31, 1977. Since this paper will be completed by late November 1977, the data will be stopped at this August date to enable the researchers to complete a thorough analysis of the data. However, the researchers will point out anticipated 1977 contract data amounts based on the trends shown during the first eight months of the year.

The three objectives of this study have been thoroughly explained in the preceding paragraphs. How they will be carried out and accomplished will be explained in the next section of this paper.

1.3 Method of Completing the Research

The final construction contract payment procedure is a type of construction engineering management technique. A process has been devised in which project engineers complete the required paperwork for a highway related construction contract. This paperwork, also known as the Construction Record, is checked by the district office, and then final payment is made to the contractor of the project.

The State of Indiana has 180 days to complete this process after project acceptance. Therefore, it was felt that in order to complete the analysis of the construction contract payment procedure, it would be best to interview those engineering managers directly involved with the process. There are several types of engineering managers associated with the procedure and the method of extracting the required information from each of them will be discussed separately.

The first type of engineering manager involved with the final construction contract payment procedure to be interviewed was the District Review Officer. There are six geographic highway districts which comprise the State of Indiana and each has a District Review Officer. The main jobs of the District Review Officer are to receive a contract's Construction Record from the project engineer, check its content for precise final work item quantities, issue final work item quantity summary sheets to receive the required material certifications, receive the contractor's approval of the final quantities, and issue the completed Construction Record to the Central Office for final payment to the contractor. As can be seen from his job duties, the District Review Officer is one of the key men in the final construction contract payment procedure. Therefore, the researchers traveled to all of the six geographic districts of the State of Indiana, talked individually with the District Review Officers and asked of each the following questions:

- a) How is the final construction contract payment procedure carried out in your district?
- b) In your opinion, what are the main reasons for interest penalties?

- c) Do you notice any differences between the Construction Records of the city, county, and state project engineers?
- d) Do you have enough personnel to complete your required duties?
- e) What are your recommendations on improving the final construction contract payment procedure?
- f) What do you think about the Construction Record Guide?
 - 1) Unnecessary sections?
 - 2) Repetition?
 - 3) Needed sections?
 - 4) Any other changes that could improve the guide?
 - 5) Unnecessary forms?
- g) Do you initiate retainage reductions?

The researcher stressed to each District Review Officer that his opinions would be held in confidence, and that his frankness would lead to a better final construction contract payment procedure.

The six interviews with the individual District Review Officers provided a lot of valuable information and recommendations for improvement of the final construction contract payment procedure. Also, the District Review Officers provided excellent suggestions on improving the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. The opinions of the District Review Officers on both the final construction contract payment procedure and the Construction Record Guide will be expressed in Chapter 3 of this paper.

The second type of Indiana State Highway Commission personnel interviewed about both the final construction contract payment

procedure and the Construction Record Guide was the project engineer of a contract. The project engineer prepares what is called the Construction Record for a project. In this document, he computes the in-place quantities of all of the work items which make up a contract. He accounts for any Change Orders to the contract or any Extra Work Agreements. He then turns the completed Construction Record over to the District Review Officer. Therefore, it can be said that the project engineer completes the first step of the final construction contract payment procedure.

An underlying reason for interviewing the project engineers was that Indiana State Highway Commission officials felt that they could be part of the problem in not meeting the 180 day deadline. No engineer likes the paperwork required for a job; so it was the feeling of the researchers that by asking various project engineers their opinions of both the final construction contract payment procedure and the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts, ideas could be obtained that could improve the efficiency of both. The project engineers and the District Review Officers work with both of these topics every day and their opinions can far outweigh those of the researchers who see these topics for a much shorter period of time.

The actual interviews of the project engineers were carried out in the Crawfordsville District of Indiana. The researchers traveled to various areas around the district, stopped at a number of jobs, and talked with several project engineers. The researchers

asked questions of the project engineers similar to the listing shown for the District Review Officers. The opinions and recommendations expressed by the project engineers can be found in Chapter 4 of this paper.

The third type of personnel interviewed about the final construction contract payment procedure was a few of the men who work at the Division of Materials and Tests in Indianapolis. This laboratory issues material certifications. From both the initial analysis of the contract data and opinions expressed by Indiana State Highway Commission officials, it quickly surfaced that this laboratory could be a cause of some of the interest penalties. Therefore, the researcher traveled to Indianapolis to discuss with the laboratory personnel how they carry out their aspect of the final construction contract payment procedure. He asked how they issue a material certification and what type of organizational structure the laboratory follows. The results of this interview can be found in Chapter 5 of this paper.

Finally, the researchers used a computer to accomplish their data analysis of past and present highway related construction contract data. How the computer program was written and what it encompasses can be seen in the Computer Program Development section (7.1) of this paper. The actual data compiled and summarized is found in Chapter 7, the Data Analysis chapter.

CHAPTER 2

AN EXPLANATION OF THE FINAL CONSTRUCTION CONTRACT PAYMENT PROCEDURE

Since this investigation is centered around the final construction contract payment procedure, an explanation of the process is in order. It should be pointed out that this elucidation of the procedure will list how it is theoretically supposed to be carried out. It was quickly discovered by the researcher in his talks with the District Review Officers that they do not all precisely follow each of the steps about to be shown. Their reasons for variances from the process will be explained in Chapter 3 of this paper, the Results of Interviews with the District Review Officers chapter.

It is felt by the researchers that the best way to illustrate the procedure is to list the steps that are followed to complete the process. Each step will be comprised of what is done in it and who participates in each component of the procedure. The final construction contract payment procedure is as follows:

- 1) COMPLETION OF MATERIAL RECORDS (IT 611)- These forms are prepared monthly throughout the project by the contractor. They are a record of all of the materials received during the month that are included in the finished project. The contractor submits the IT 611's to the project engineer who in turn checks them both for proper quantities and for representation of all items received on the job during the

month. This is necessary because the contractor sometimes computes quantities incorrectly or omits work items. After the Material Record has been checked each month, the project engineer forwards it to his District Review Officer who in turn forwards copies to the District Office Materials' Laboratory and the Division of Materials and Tests.

- 2) COMPLETION OF THE CONSTRUCTION RECORD- This document is prepared by the project engineer and is submitted to the District Office. For each work item of the contract, the project engineer compares the plan quantity with the quantity in place. Overruns and underruns are noted. This data provides the necessary information for the State of Indiana to make contract price adjustments to the originally estimated total contract price.
- 3) DISTRIBUTION OF PRELIMINARY WORK ITEM QUANTITIES- After the Construction Record is received in the District Office, the District Review Officer transfers the as-built work item quantities onto an IC 642 form which is entitled Comparison of Estimates- Original and Final. He issues this form to both the District Office Materials' Laboratory and the Division of Materials and Tests as preliminary contract quantities. They in turn begin checking to see if the quantities of work items shown on the Material Records sent to them previously are equal to or greater than the quantities shown on the IC 642.

4) CHECKING OF THE CONSTRUCTION RECORD IN THE DISTRICT OFFICE-

After sending out the preliminary quantities, the District Review Officer and his subordinates begin a thorough check of the Construction Record. They check to make sure that the project engineer has made no mathematical errors in his work item quantity calculations, that all of the work items in the contract show up in the Construction Record, that the field books are cross referenced with the Construction Record, and that all of the proper forms required by the Construction Record Guide are included in the project engineer's Construction Record.

5) DISTRIBUTION OF THE FINAL WORK ITEM QUANTITIES- After the

Construction Record has been checked in the District Office, the District Review Officer then issues an IC 642 form containing final work item quantities to both the District Office Materials' Laboratory and the Division of Materials and Tests. They had begun their comparison of in-place quantities with Material Record quantities using the preliminary IC 642; now, they can complete the procedure using the final IC 642.

6) ISSUANCE OF THE DISTRICT OFFICE MATERIAL CERTIFICATION- After

it has determined that the in-place work item quantities agree with the Material Record quantities, the District Office Materials' Laboratory issues a District Office Material Certification to the Division of Materials and Tests. The District Office is notified of this also.

7) ISSUANCE OF THE DIVISION OF MATERIALS AND TESTS CERTIFICATION-

After it has satisfactorily completed its check of final IC 642 quantities with Material Record quantities, have made the determination that the required number of sample tests have been taken, and have been notified that the District Office Materials' Laboratory has issued a material certification, the Division of Materials and Tests issues its certification and notifies the District Office of this fact.

8) ISSUANCE OF THE M-39, THE CONTRACTOR'S INSPECTION OF THE

FINAL CONSTRUCTION RECORD REPORT- After both of the material certifications have been received in the District Office, the District Office issues a final quantity IC 642 and the M-39 form to the contractor. This is done so the contractor can check to see if he agrees with the in-place quantities along with the final contract total dollar amount. If the contractor agrees with the work item quantities and the total contract amount, he signs the M-39 and returns it to the District Office. If he does not agree, negotiations on the dispute begin.

9) TRANSMITTAL OF THE CONSTRUCTION RECORD TO THE CENTRAL OFFICE-

When the M-39 is received signed from the contractor, the complete Construction Record is sent to the Central Office for additional checking and payment approval.

10) PAYMENT TO THE CONTRACTOR- After receiving the Construction

Record from the District Office, personnel in the Central

Office check it and if it meets their approval, a check is issued to the contractor for the final amount of money due him.

The final construction contract payment procedure is illustrated in the flowchart shown in Figure 1. The blocks signify persons or places involved in the procedure while the arrows indicate activities between them. The numbers along the arrows are explained on page 21. It should be kept in mind that the procedure explained and shown in the flowchart form is the theoretical procedure. The variations to the final construction contract payment procedure as expressed by the District Review Officers will be shown in the Results of Interviews with the District Review Officers chapter of this paper (Chapter 3).

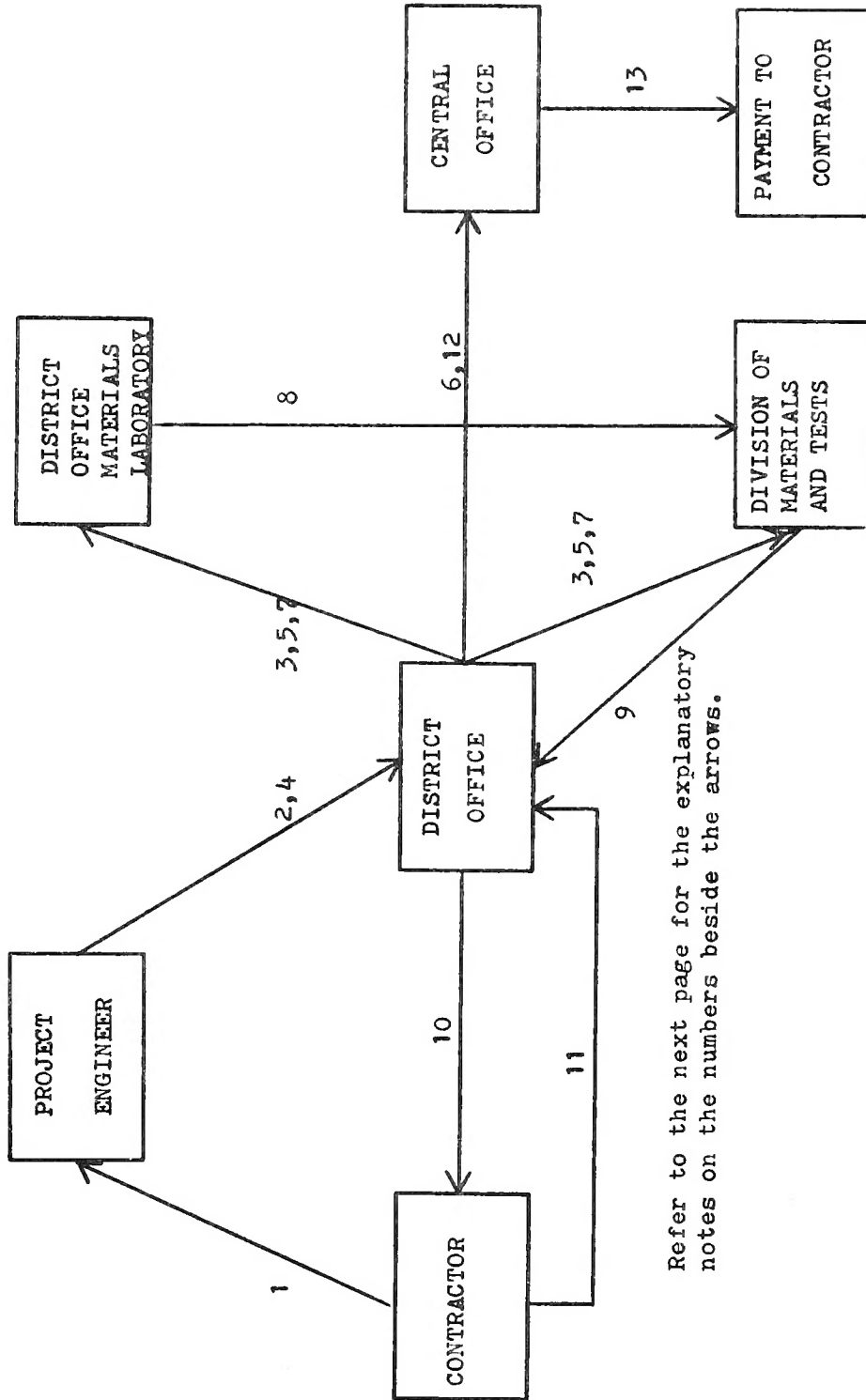


Figure 1

FINAL CONSTRUCTION CONTRACT PAYMENT PROCEDURE FLOWCHART

EXPLANATORY NOTES FOR THE FINAL CONSTRUCTION CONTRACT

PAYMENT PROCEDURE FLOWCHART

- 1) Contractor completes and issues a Material Record form (IT 611) each month.
- 2) Project engineer sends in the checked IT 611 each month.
- 3) The district office passes on the IT 611 each month to the testing laboratories.
- 4) Project engineer completes and sends in the Final Construction Record.
- 5) District office issues preliminary work item quantities on an IC 642 form to the testing laboratories.
- 6) District office checks the Final Construction Record.
- 7) District office issues final work item quantities on an IC 642 form to the testing laboratories.
- 8) District Office Material's Laboratory issues their materials' certification to the Division of Materials and Tests.
- 9) Division of Materials and Tests issues their materials' certification.
- 10) District office sends a final quantity IC 642 and an M-39 form to the contractor.
- 11) Contractor sends in the signed M-39.
- 12) District office sends the completed Final Construction Record to the Central Office.
- 13) Central Office checks the Final Construction Record and issues the final payment to the contractor.

Figure 1, cont.

CHAPTER 3

RESULTS OF INTERVIEWS WITH THE DISTRICT REVIEW OFFICERS

The researchers traveled to all six State of Indiana highway districts and spoke with the District Review Officer in each district. This man is responsible for reviewing a contract's Construction Record received from the project engineer, checking its content for precise work item quantities, issuing final work item quantity summary sheets to receive the required material certifications, receiving the contractor's approval of the final quantities, and issuing the completed Construction Record to the Central Office for final payment to the contractor. Each District Review Officer was asked a set of questions which were listed in Section 1.3 of this paper. The results of these interviews ~~will~~ be discussed in the following sections, each of which pertains to a certain topic of discussion.

3.1 Final Construction Contract Payment Procedure Flow in the Districts

A discussion of how the final construction contract payment procedure is theoretically supposed to be carried out was made in Chapter 2 of this paper. This procedure was condensed into the flowchart seen in Figure 1 on page 20. Each of the District Review Officers was asked if he followed the theoretical procedure and it was found that not all of them did. In fact, only one of the

districts out of six follows the final construction contract payment procedure step by step. There are two primary deviations to the procedure with three out of six of the districts practicing the first one and two out of six practicing the second. The first deals with preliminary and final quantities on the IC 642 forms. The procedure calls for the District Review Officer to transfer the work item quantities calculated by the project engineer onto an IC 642 and to send these preliminary quantities to both material certification laboratories so they can begin their certifications. The District Review Officers are then supposed to check the Construction Record and the work item quantities within it. They then issue final quantity IC 642's to the laboratories. It was discovered and the researchers concur in this practice that the majority of the districts do not issue preliminary quantities to the certification laboratories. The District Review Officers in these districts stated that it usually only takes them a few days to check a Construction Record. Therefore, they feel that it is unnecessary to issue preliminary quantity IC 642's to the laboratories and then three or four days later issue final quantity IC 642's. However, the districts do realize that if a work item quantity is in dispute or if it takes a long time to check (such as dirt cut and fill), they will issue preliminary quantities to the certification labs in this case.

The second procedural nonconformance deals with the issuance of the M-39 form which is the Contractor's Inspection of the Final Construction Record Report. The theoretical procedure calls for issuance of the form to the contractor after the District Review

Officer receives both material certifications. However, due to past problems dealing with long waits for material certifications, two of the districts send out an M-39 when they have determined what the final work item quantities will be. The researchers feel that this is a bad practice and that these two districts should revert to the specified procedure. Many times, items are left off Material Record forms by the contractors. This changes work item quantities which then change the contract price shown on the M-39. If this happens, a new M-39 has to be sent to the contractor. Therefore, waiting for both material certifications before issuing the M-39 seems to be the most feasible thing to do. It should also be kept in mind that the time spent waiting for the M-39 form to be returned from the contractor is not charged towards the State's 180 day payment period.

3.2 Causes of Interest Penalties

All of the six District Review Officers were asked what they thought were the main reasons for interest penalties and each gave essentially the same answers. The two reasons mentioned by all were project engineer paperwork problems, and late issuance of the Division of Materials and Tests certification. As will be seen in Chapter 7, the Data Analysis chapter, the contractual data correlates with the opinions of the District Review Officers. Several men stated that there are certain project engineers in their districts who chronically turn in the Construction Record either wrong, late, or incomplete. They can tell by the project engineer's name on the Construction Record whether they are going to have trouble checking it or not. Also, there are several project engineers in each district who turn

the Construction Records in early and correct almost every time. It seems as though all project engineers should attend periodic workshops on the preparation of Construction Records taught by District Review Officers. This would clarify the mistakes that are made, along with having the project engineers hear suggestions or "tricks of the trade" from their peers.

The late issuance of the Division of Materials and Tests certification also upsets most of the District Review Officers. Few know why this was happening. However, recent changes in the procedure of the Division of Materials and Tests as will be discussed in Chapter 5 of this paper should greatly alleviate this reason for interest penalties.

A few other reasons for interest penalties were stated by the District Review Officers. These included late District Office Materials' Laboratory certifications, variations in the types of project engineers (city, county, or state), the Failure Committee at the Central Office meets only once a month, and that the Central Office requires too many reports (daily, weekly, and monthly). The only one of these of major consequence is the variation of project engineer type. It and another reason will be discussed in the next two sub-sections.

3.2.1 Construction Record Versus Type of Project Engineer

The District Review Officers stated that they noticed a great difference between the quality of Construction Records prepared by the state project engineers and those put together by the city or county project engineers. They said that the city and county project engineers make many more mistakes in completing the Construction

Record than do the State of Indiana project engineers. This is probably due to the more experience the state project engineers have in completing a Construction Record. A few of the District Review Officers stated that they find it easier to personally correct many of the mistakes of the city or county project engineers rather than having them come in to correct the Construction Record. It seems to the researchers that the city and county project engineers should also attend the proposed Construction Record workshops taught by the District Review Officers. Experience will not help them if they keep completing the Construction Record incorrectly.

3.2.2 District Office Material Certifications

Only one District Review Officer expressed that he sometimes has problems getting District Office Materials' Laboratory certifications. The other five men seemed to have very good rapport with the district testing men and it only takes one to three days to get a certification in these districts. One District Review Officer even expressed the fact the the material's laboratory in his district has agreed to work on those contracts which are late in the 180 day payment period first. This type of cooperation saves the State of Indiana money in interest penalties.

3.3 Review Personnel

It was quickly discovered by the researchers that the majority of the districts vary with respect to the personnel completing the final construction contract payment procedure review process. All of the districts obtain extra personnel during the winter months

due to inclement weather making field personnel available for office work. However, during the remainder of the year, two District Review Officers work by themselves in completing the reviewing and checking of the Construction Records. The number of review personnel in the other four districts including the District Review Officer varies from three to six. In the districts which have review personnel besides the District Review Officer, each Construction Record is usually broken down so that the same person checks the same work item categories for each contract. This helps to reduce the number of review errors. However, a few of these districts allow one person to review the entire Construction Record if it is for a small contract. Not one of the District Review Officers stated that he needed more review personnel-- including the two men who work alone. However, the researchers feel that a recommendation is in order here. It seems that something is wrong with the personnel utilization system of the Indiana State Highway Commission when it assigns six review men to one district and only one to another. The amazing fact is that the two districts operating with only a District Review Officer had two of the lowest interest penalty percentages and totals for the 1972 through 1976 contractual data. Therefore, the researchers propose that each District Review Officer should be assigned a field-experienced assistant, and that these two persons should carry out the entire review procedure. This would eliminate **unneeded** personnel, along with allowing those two District Review Officers without assistants some relief. In view of the fact that fewer highway related contracts are being let due to the near completion of the interstate

system, two review officers should suffice for each district.

3.4 District Review Officer Interaction

All of the District Review Officers expressed the fact that there has been no interaction between them for five to six years. Only two of the six know one another. All said that they would like to have an annual meeting where they could discuss construction contract procedures. It seems as though this would be a very good idea. The six District Review Officers could get together with personnel from the Central Office and discuss general procedures, possible improvements, and problems encountered at the present. Each District Review Officer could state a few of his problems and others of the group who might have already solved the same problems could present their solutions. Another reason for the annual meeting is to prevent gross divergence from contract procedures. At the present, the six District Review Officers are all following their own pathways. These are not too different from the stipulated procedure; however, there is the possibility of ending up with six different payment procedures in the future. The researchers feel that the District Review Officers would be more than willing to participate in such joint meetings.

3.5 Recommendations for Improving the Final Construction Contract

Payment Procedure

Most of the District Review Officers discussed the fact of late initiation of needed change orders by the project engineers. A change order is required any time there is a change from the original

plans or estimate which makes the total contract amount increase. The project engineer then documents this change with its anticipated cost on an IC 626 form which is entitled a Recommended Change in Plans, Materials, or Quantities. Two problems have arisen out of the use of this form. First, many project engineers wait until the end of the job to initiate this form, even though the change took place much earlier in the project. This holds up the payment procedure process and the District Review Officers feel that this is mainly due to inexperienced project engineers. Again, an annual workshop for project engineers would help to alleviate this problem. Secondly, some of the District Review Officers say that the project engineers do not complete an IC 626 until they have exact quantities. It is felt that if a change can be foreseen but exact quantities are not known, such as with cut and fill, it would be better to begin the process by turning in an estimated IC 626 so the Indiana State Highway Commission will know it needs extra money for this contract.

Only one District Review Officer did not agree with the policy of working on Construction Records that are late in the 180 day payment period first. Five of them stated that if they are working on other Construction Records and one comes in which is late and which will have a substantial interest penalty if not processed promptly, they will switch their efforts over to this new one. This shows the desire of the District Review Officers of having the lowest penalty amount possible. The sixth District Review Officer brought up the point that looks at things from the contractor's point of view. By working on the late contract first, you save money for the State

of Indiana. However, why should the contractors whose contracts were turned in earlier have to wait for their final payment just so the State of Indiana saves money? The researchers can see this District Review Officer's point, but it should be remembered that he is working for the State of Indiana, not the contractors. Therefore, he is obligated to save as much money for the State of Indiana as he can.

A third recommended improvement deals with retainage reductions. Several of the District Review Officers feel that retainages could be dropped much sooner than they actually are. A dropped retainage saves many dollars in interest penalties. Because of this, when some of the District Review Officers see that the final construction contract payment procedure is running late, they mention to the Construction Engineer of the district that it might be a good idea to lower the percentage retained. Since the contractor has to make the formal request, he is informed that the State of Indiana is willing to make the reduction. No contractor with any common sense will reject this offer; however, the State of Indiana must protect itself before dropping the retainage. If the contract is running late and liquidated damages are due to the State of Indiana, the chances of dropping the retainage are much slimmer. Therefore, the State of Indiana must weigh two evils here-- leave the retainage as it is and pay a higher penalty or drop it and take the chance of not recovering the liquidated damages. Only a value engineering judgement for each individual case will give the correct answer. The point of this improvement idea is to reduce the retainage as much and as soon as possible.

Another recommendation deals with job personnel. One of the District Review Officers mentioned that every project engineer should be assigned an assistant. Some have them now and some do not. This assistant could work in the field office trailer and be completing a lot of the Construction Record paperwork throughout the job, such as making the necessary sketches and adding up all of the weigh tickets. This would give the project engineer more time on the job and make it an easier task to complete the Construction Record at the end of the project.

Another improvement suggestion deals with checking the Construction Record in sections throughout the job. All jobs are divided into components and a lot of the time a part is completed early in the job and no work is added to it later. In cases like this, a District Review Officer mentioned that he tells his project engineers to complete the paperwork for this part of the job and send it to the District Office whenever it is completed. This way, the whole Construction Record does not have to be checked at the end of the job. It seems as though this is a very good idea which could induce the project engineers to do a little of their work at a time instead of waiting until the end of the job to do it. Also, dealing with this is what one of the District Review Officers does in his district. If there is not much to check in the office, he will periodically go to the jobs and pick up from the project engineers items such as weigh tickets so he can get them all tabulated prior to when the Construction Record arrives. This saves him a lot of time in the long run.

A few of the District Review Officers seem to have a good idea with respect to organization throughout the checking process. They have a board in front of their desk showing the status of each contract being checked. Using this system, they can tell which contracts are running late in the 180 day payment period. This type of organization should be used throughout all six highway districts.

Added documentation is another recommendation of one of the District Review Officers. He stated that the project engineers are accustomed to calling contractors when supplemental material records are needed or when the M-39 is late being turned back signed. Because of this verbal system, some contractors claim they were never called and try to pin the time delay on the State of Indiana. Dated written letters of which copies are kept by the project engineer would help to alleviate such claims.

Finally, a few of the District Review Officers stated that their work might improve if they knew what their exact job description is. For example, they sometimes find numerical errors made by the project engineer during his calculations. The District Review Officer can either make the needed change himself or call the project engineer in to do this. In most cases, they make the change themselves. However, they are afraid of the possible consequences. One is so bold that he will fill in a supplemental material record and forge the project engineer's signature to it because this document is all that is holding up material certifications. As can be seen, some guidelines need to be set up so these men know what they can and cannot do legally.

3.6 Recommendations for Improving the Indiana State Highway Commission
1970 Construction Record Guide for Road, Bridge, Maintenance, and
Traffic Contracts

None of the District Review Officers voiced any major complaints about the Construction Record Guide. All felt that it served its purpose on the whole, but they did each give the researchers a few of their suggestions on how it could be improved. Most of these deal with certain forms placed in the Construction Record. However, a few deal with needed sections. Each will be discussed separately below.

- a) Repetition of sketches- Several District Review Officers said that many of the project engineers recopy their field book sketches onto IC 614 forms. This type of repetition is unnecessary. If they would take their time when drawing their original field sketches, the field book containing them could be referenced for a needed sketch. The field books become a part of the Construction Record anyway. This would cut down on the amount of paperwork in the Construction Record along with making it easier for both the project engineer and the District Review Officer.
- b) Bridge deck repair items- Two of the District Review Officers mentioned that the Construction Record Guide contains no section showing samples of how to check bridge deck repair and overlay items. These items include hand chipping and scarifying. The District Review Officers are not sure of the proper quantities for these items and feel a section is needed to cover this topic.

- c) Accuracy of calculations- It was mentioned that several of the project engineers are not following the calculation accuracies shown for the work items in the front of the Construction Record Guide. They are not following the rounding rules for the quantities. Again, an annual workshop for the project engineers should help clear up this problem.
- d) Federal funding section- One of the District Review Officers said that he would like to see a new section in the Construction Record Guide on how to handle federally funded contracts. In these contracts, there are often work items, signified as Z items, which are not federally funded while the rest of the contract is. As a note to the District Review Officers, this problem is adequately discussed in the Supplemental Instructions to Field Employees--No. 18 which was issued September 7, 1973 by W. J. Ritman, Chief of the Division of Construction of the Indiana State Highway Commission. A copy of this directive could easily be included in the Construction Record Guide.
- e) IC 612B form- Pipe and Concrete Structures- The majority of the District Review Officers feel that this form is useless. It is used to show how much of each type of pipe is laid and where. It is felt that this form repeats information shown in the project engineer's field book and is unnecessary. Therefore, the pipe information could be referenced on an IC 627 to the field book and this IC 612B form could be eliminated.

- f) Computerized dirt quantities- At present, the computer does a lot of the project engineer's dirt calculations for him. He fills out a data input sheet using numbers from his field book and the computer prints out quantities and cross sections. This printout is then included in the Construction Record. However, a District Review Officer expressed concern as to how to check these computer printouts. The only thing he can check at the present is whether the project engineer made the proper transposition of field book numbers to the computer data input sheets. There is no way of his knowing if the project engineer made an error in his field-book. Therefore, the District Review Officers need actual as-built cross sections to compare with the computer's printout.
- g) IC 611A form- Pavement- This form for pavement quantities is also felt to be unnecessary by some of the District Review Officers. This same information should be in the project engineer's field book.
- h) IC 654 form- Record of Construction (Concrete)- This form was revised in May 1972 so the old form is still in the Construction Record Guide. A few of the District Review Officers mentioned that they are not sure what goes in all of the blocks on this form. A new sample form which is explained should be placed in the Construction Record Guide. A meeting between the District Review Officers would help clear up this problem also.
- i) Date repetition- A few of the District Review Officers felt

that there was unneeded repetition of dates on forms such as the IC 608 (Title Sheet), the IC 654 (Record of Construction-Concrete), the IC 635 (Record of Completion and Acceptance), and the IC 632 (Completion Date and Liquidated Damage Data). However, these forms are all required to be in the Construction Record and some of the repeated dates are pertinent to the form. Therefore, the researchers feel that this repetition of dates is all right as long as care is taken so that the dates do not vary from form to form.

3.7 Summary

As can be seen, the District Review Officers provided a lot of valuable information that the researchers used in preparing this chapter. The places of disagreement between those men and the researchers were noted. It is felt that a lot of the suggestions offered by the District Review Officers would greatly increase the efficiency of the final construction contract payment procedure.

CHAPTER 4

RESULTS OF INTERVIEWS WITH ISHC PROJECT ENGINEERS

As was stated in Section 1.3 of this paper, interviews with several project engineers were carried out in the Crawfordsville district. The main reason for this was because of this district's proximity to Purdue University. The project engineers responded to a set of questions similar to those asked the District Review Officers. However, the primary emphasis of the questioning was placed upon the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. The project engineers use this manual the most of all of the Indiana State Highway Commission personnel. Therefore, their familiarity with the book made it easy for them to state their likes and dislikes about it.

The primary point that each of the interviewed project engineers made about the Construction Record Guide is that it is not too bad. It is not hard to follow and it contains the answers to most of the questions that arise during the preparation of the Construction Record. However, each did present a few suggestions on how the book could be improved. It should be noted here that a lot of their suggestions about the Construction Record Guide are the same as were given by the District Review Officers. Since these identical suggestions are explained in Chapter 3 of this paper, they will only

be listed here. However, previously unexplained suggestions will be presented in detail. Also, general suggestions about the final construction contract payment procedure as were put forth by the project engineers will be listed. The following three sections present the results of the interviews with the project engineers.

4.1 Suggestions about the Construction Record Guide Which Were Made by Both the Project Engineers and the District Review Officers

- a) Repetition of sketches is unnecessary.
- b) Bridge deck repair item needed in the the Construction Record Guide.
- c) Difficulty of filling out the IC 612B form pertaining to pipe and concrete structures.

4.2 Other Project Engineer Suggestions on Improving the Construction Record Guide

- a) Make more references to the project engineer's field book.
Many of the project engineers feel that there is a lot of recopying of field book information onto IC 615 forms which are placed in the Construction Record. These IC 615 forms are used mainly for drawings. It is felt that it would involve much less paperwork if the pertinent page in the field book was referenced instead of writing up a new form. The researchers concur in this belief.
- b) Provide all project engineers with a sheet showing the Central Office's recommendation for the order of pages in the Construction Record. This sheet should be used by all six

State of Indiana districts. The project engineers complained that the page order of the required forms changes from time to time and a general instruction sheet from the Central Office would be very helpful.

- c) Provide an example of Unclassified Excavation.

4.3 Project Engineer Suggestions on the Payment Procedure Process

- a) In order to speed up the process, the project engineer could begin filling out the IC 627 forms for each work item before the actual project even begins. IC 627 forms are used for work item quantity summaries and comparisons. He could fill in the heading and the plan quantities. Then as each item is finished, he could complete the IC 627.
- b) In order to check the contractor's IT 611 form (the Material Record form), the project engineer could make up his own each month from his observations and then at the end of the month, check the form turned in by the contractor with his own. His form would give him a record of what material he knows is on the job and it would reduce the amount of checking required to determine if the contractor left something off or had an improper quantity.
- c) It would be better to be conservative and overestimate on the IC 626 forms. An IC 626 is a form entitled Change in Plans, Materials, or Quantities. The project engineer fills out this recommendation form if he encounters any work item quantity changes during the project. Being

conservative on this form would assure that if approved, the money would be available and hopefully some of it would not be used.

- d) Require all District Review Officers to be field experienced and graduate civil engineers. The reason for this deals with their checking responsibility. Right now, their main job is to sum quantities and to make sure all of the required forms have been submitted by the project engineer. They do not check the thought behind how these quantities were arrived at. If they do have a quantity question, the project engineer is able to give an explanation that the District Review Officer does not sometimes understand but assumes is feasible. Therefore, it would be better to have a person checking the Construction Record who is also capable of checking the project engineer's method of calculating quantities.

4.4 Summary

As can be seen from the number of suggestions provided by the project engineers, they do not have too many complaints about the payment procedure or the Construction Record Guide. However, through interviewing the project engineers, the researchers discovered that both the Indiana State Highway Commission officials (including the District Review Officers) and the contractual data are correct about the project engineers. Most do not finish their paperwork as soon as they could. Only a few out of the several project engineers

who were talked to stated that when a work item is completed, they immediately complete the required paperwork that goes along with it. This one step would reduce the amount of paperwork time being spent at the end of the job and this would reduce interest penalties.

The researchers realize that no one likes to do the paperwork but it is a necessary evil. To put it off because you could be doing something else only makes you resent it more when you have to do it later. Therefore, it is recommended that the Indiana State Highway Commission strongly emphasize to its project engineers the expediency of completing construction reports as segments of the work already completed. District Review Officers and the District Construction Engineers could also implement this philosophy into practice. Project engineers who continue to perform poorly on project reports should be relieved of their positions.

CHAPTER 5

RESULTS OF INTERVIEWS AT THE DIVISION OF MATERIALS AND TESTS

As was seen on the final construction contract payment procedure flowchart in Figure 1, the issuance of a Division of Materials and Tests certification is one of the primary components of the process. This division of the Indiana State Highway Commission is located in Indianapolis. In the researchers' interviews with Indiana State Highway Commission officers in the Indianapolis Central Office, with the District Review Officers, and with the project engineers, this division was constantly mentioned as one of the main reasons that interest penalties were occurring. The Penalty History Analysis section (7.7) of the Data Analysis chapter presents data that substantiates this opinion. Therefore, the researchers traveled to the Division of Materials and Tests assuming it contributed to one of the final construction contract payment procedure's main problems and hoped that by talking to the personnel there that they could discover the basis for the problems. They also hoped to come up with recommendations that might improve this division. The researchers found something quite the contrary when they interviewed three of the men there. There has been a change in procedure at the Division of Materials and Tests which began approximately in March of 1977. It looks as though the efficiency of the division will be greatly increased by this new procedure and, hopefully, reductions in

future contract penalty data will bear this out. Some of their old policies did contribute to their division being a major cause of interest penalties, but most of those policies have been changed. Therefore, this chapter will present information in the following sections:

- 5.1 The Functions of the Division of Materials and Tests
- 5.2 The Organizational Structure of the Division of Materials and Tests
- 5.3 The Flow of Paperwork Through the Division of Materials and Tests
- 5.4 Management Checks to Increase the Division's Efficiency
- 5.5 Possible Reasons for Late Issuance of a Division of Materials and Tests Certification That Are Not the Fault of the Division
- 5.6 Recommendations
- 5.7 Summary

5.1 The Functions of the Division of Materials and Tests

The primary objective of the Division of Materials and Tests is to certify that all materials used on a construction project meet State of Indiana specifications. It accomplishes this either by testing a sample of each material in its laboratories or by checking a manufacturer's certification test. The Division of Materials and Tests also checks to make sure that for each quantity of material used on a project, the right frequency of sample spot checks have been made. For example, a slump test is required for all concrete

paving operations. The Manual for Frequency of Sampling and Testing and Basis for Use of Materials states that one slump test is required for every 2000 linear feet of pavement but no fewer than one slump test should be taken each day. Therefore, if 4000 linear feet of concrete pavement are laid in one day, the Division of Materials and Tests makes sure two slump test reports are sent to them for checking. The third category the Division of Materials and Tests checks is the basis for use of materials used on a contract. When a project engineer fills in the Basis for Use column on the Material Record form (IT 611), he is showing his criteria for accepting the material for his construction project. He can justify material acceptance either by a Division of Materials and Tests sample test, a manufacturer's certification, or by visual approval. However, certain materials require a certain test to show up on the Basis for Use column to assure the material is all right to use on the job. For example, there are three types of material certifications that can be received from a manufacturer-- namely A, B, and C. Type A is the highest level of certification in that it contains with it a certified copy of a laboratory report showing actual test results which meet State of Indiana specifications on the material tested. The type C certification is the lowest level since it certifies only that the material supplied by the manufacturer complies with the State of Indiana specifications. Therefore, if a material calls for a type C certification in the Basis for Use column, a type A, type B, or type C certification will suffice. However, if a type A certification is called for and a type C is received from the manufacturer, the project

engineer cannot accept the material. Using the Manual for Frequency of Sampling and Testing and Basis for Use of Materials, the Division of Materials and Tests makes sure that the project engineer has made no mistakes in approving materials without the proper testing certification. The fourth and final set of information that the Division of Materials and Tests checks for on each contract is final payment quantities. Every month, it receives Material Record forms (IT 611) that show the quantity of each material used by the contractor during the month. At the end of the project, these monthly totals for each work item are summed to arrive at job quantities. The Division of Materials and Tests also receives at the end of the job IC 642 forms. These forms, entitled Comparison of Estimates--Original and Final, show the final quantity of each work item for which the State of Indiana expects to pay the contractor. The Division of Materials and Tests makes sure that its quantity totals derived from the IT 611's are equal to or greater than the payment quantities shown on the IC 642. If the totals on the IT 611's are smaller, this could mean that without this checking procedure, the State of Indiana could end up paying for more material than was used on a job. If the totals are larger, the State is getting more material than it is paying for.

5.2 The Organizational Structure of the Division of Materials and Tests

The Division of Materials and Tests is composed of four divisions. Each is responsible for checking different work item quantities on both the IT 611's and the IC 642's. The first division is called Field Control. It is responsible for checking quantities on work items such as pipe and its accessories, aggregates, and bituminous

materials. The second division is the Soil Department. It checks soil quantities such as those for B-Borrow, compacted base material, and common excavation. The third section is entitled Research and Development and the primary category of work items that it checks is concrete. The fourth division is called the General Office. It checks items such as dry cement, asphalt, reinforcing steel, and metal products such as signs or guardrails. Due to the fact that each division checks different work item quantities, all of the paperwork has to flow through all four divisions; how this is accomplished is explained in the next section.

5.3 The Flow of Paperwork Through the Division of Materials and Tests

How the paperwork flows through the Division of Materials and Tests is very important to its efficiency. Each step in the process will be discussed in detail and improvements to the procedure which were made in March 1977 will be pointed out. The steps are as follows:

a) RECEIPT AND CHECKING OF THE MATERIAL RECORD FORMS (IT 611)-

Each month in which a project is in progress, the Division of Materials and Tests receives an IT 611 for every project that is in progress in each district. This form is sent from the District Office. It is logged in on a sheet showing the date it was received. The IT 611 then has a distribution stamp place on it by the Assistant to the Office Engineer for routing through all four sections of the Division of Materials and Tests. He then starts the form's distribution to a division such as Field Control. The IT 611 is hand carried to Field Control which checks to make sure the

correct number of sample tests have been completed for each work item shown on the IT 611 along with checking that the Basis for Use column and the Source of Supply column for each work item are correct. After sending the IT 611 to one of the four divisions, the Assistant to the Office Engineer expects the checked IT 611 to be back on his desk within a week in order to distribute it to the next division. If it is not, he goes to that division and picks it up himself after making sure it was checked. Prior to March 1977, after sending the IT 611 to a division, there was no requirement that it be back to the central distribution point within a week. It would sometimes sit on a man's desk for weeks or even months if the man happened to be sick, on vacation, or just busy. This change in procedure alone should greatly increase the efficiency of the Division of Materials and Tests and decrease the number of times it is a cause for an interest penalty. As was stated previously, this checking process is repeated monthly for each new set of IT 611's that arrives at the Division of Materials and Tests from the districts. The division strives to complete this checking process prior to the arrival of the new crop of IT 611's. This prevents a backlog of work along with utilizing the common sense policy of doing your work a little at a time instead of waiting until the end of the job to begin it.

b) RECEIPT AND CHECKING OF THE PRELIMINARY COMPARISON OF ESTIMATES-

ORIGINAL AND FINAL FORM (IC 642)- After the project has been completed and the project engineer has turned in the Construction Record to the District Office, they transfer his work item total quantities onto an IC 642 which is sent to the Division of Materials and Tests. This form is then logged in by the Assistant to the Office Engineer who also places the distribution stamp on it. It is then sent to each division in the same manner as the IT 611's were. If the IC 642 is not back within a week, he goes looking for it and finds out why there is a hold-up in the process. Each division totals up the IT 611 quantities it has checked for the project and makes sure this sum is equal to or greater than the sum shown on the IC 642. If the sum of a work item is smaller, a discrepancy letter is issued to the district explaining the problem and asking for its assistance in solving it. Many times, an IT 611 is not sent to the Division of Materials and Tests and this makes the IT 611 total quantity less than the IC 642 quantity. Also, a contractor frequently leaves off an item on the IT 611 which is missed by the project engineer who checks this form. This makes the IT 611 total work item quantity too low. A supplemental IT 611 is needed in this case to make sure the IT 611 total quantity is equal to or greater than the IC 642 quantity. When answers are received to the discrepancy letter, the quantities can then be okayed. If an answer is not received

within two weeks, a call is made to find out why.

c) RECEIPT AND CHECKING OF THE FINAL COMPARISON OF ESTIMATES-

ORIGINAL AND FINAL FORM (IC 642)- After the District Office has checked the Construction Record for final work item quantities, it issues a final IC 642 to the Division of Materials and Tests. This form usually shows the same work item quantities that were seen on the preliminary IC 642. Because of this, the Assistant to the Office Engineer checks this form against the IT 611 total quantities. However, if a work item on the final IC 642 shows a big change in quantity from the preliminary IC 642, he sends the final IC 642 to the appropriate division in the Division of Materials and Tests for checking.

d) RECEIPT OF THE DISTRICT OFFICE MATERIALS' LABORATORY

CERTIFICATION- The District Office is also required to submit a material certification on items that it tests. The District Office Materials' Laboratory checks items such as aggregate gradation and air content of concrete but it does not have the capability of checking things such as the tensile strength of reinforcing steel, paint mixtures, epoxy characteristics, or the compressive strength of concrete. Therefore, the Division of Materials and Tests must wait and make sure the District Office Materials' Laboratory issues its certification. After this has been done and a copy has been sent to the Division of Materials and Tests, it can then issue the Division of Materials and Tests certification.

e) ISSUANCE OF THE DIVISION OF MATERIALS AND TESTS CERTIFICATION-

Many facts have to be assured before the issuance of the certification. They are as follows:

- 1) All of the discrepancy letters to the districts have had to have been answered satisfactorily. The needed IT 611's or supplementary IT 611's must have been received and checked in the Division of Materials and Tests.
- 2) A copy of the District Office Materials' Laboratory certification must be on file in the Division of Materials and Tests.
- 3) Throughout the project, the Division of Materials and Tests is testing samples of materials used on the job. If any of the samples fail to meet the specifications, a pink sheet is issued to the project engineer notifying him of this fact. The failures are also discussed once a month by the Failure Committee in the Central Office in Indianapolis. They determine if the material can be used or if new material is required. If the failed material is approved by the Failure Committee, the Division of Materials and Tests then writes exception letters to the districts and project engineers about these failures. All of the failed material pink sheets have to be cleared up prior to the issuance of the Division of Materials and Tests certification.

- 4) If a project engineer has put down the wrong basis for use for a work item on the IT 611, a blue letter is issued notifying him of this fact. All correct basis for use certifications are required prior to certification issuance.

After all of the four facts as discussed above have been assured along with those pertaining to the IT 611's and the IC 642's, the Division of Materials and Tests issues its certification.

5.4 Management Checks to Increase the Division's Efficiency

In order to increase its efficiency and to assure that it causes a low percentage of the interest penalties, the Division of Materials and Tests utilizes a few checking systems which are the responsibility of the Assistant to the Office Engineer. The first of these is the IT 611 summary sheet. The Division of Materials and Tests knows all of the contracts that are in progress by its receipt of an IT 611 each month from all contracts. It keeps track of all IT 611's that are received and it compiles a list of all IT 611's that were not received during the month for contracts still in progress. The Division of Materials and Tests knows a contract is still in progress if it has not yet received an IC 642 from the District Office. This list is then sent to each district every month. The district is required to respond about all IT 611's pertaining to it that have not been received by the Division of Materials and Tests. This checking system finds mistakes sooner and should decrease interest penalties. The second checking system pertains to the IC 727 form

issued by the Indiana State Highway Commission each month. This form, entitled the Road and Bridge Construction Record Status Report, lists all contracts which have been completed but for which final payments have not been made. It lists reasons why the final construction contract payment procedure is still in progress. Many of the reason entries state that the contract is awaiting Division of Materials and Tests certification. The Assistant to the Office Engineer goes over every contract on this form each month and checks to see what his division's status is in the flow of its checking procedure. He makes sure all of his contract IT 611 and IC 642 checking is up to date along with determining if the hold-up is due not to his office but to the District Office or the project engineer. This checking system makes the Division of Materials and Tests aware of the status of all contracts and should lead to fewer interest penalty causing errors. The third and final checking system deals with the distribution stamp already mentioned. For every contract that the Division of Materials and Tests is working on, a form is stamped showing the four different divisions and the dates the IT 611's and the IC 642's were sent to and received from the divisions. If blanks show up on the date blocks, it means that the forms are still in a certain division or haven't been sent there yet. This checking procedure assures complete distribution along with making the Assistant to the Office Engineer aware of any long delays in a certain section. All three of the mentioned checking systems appear very adequate and can do nothing but to improve the final construction contract payment procedure.

5.5 Possible Reasons for Late Issuance of a Division of Materials and Tests Certification That Are Not the Fault of the Division

In defense of the Division of Materials and Tests, it appears that this group is blamed for a lot of delays in the final construction contract payment procedure which are the fault of other groups of people. When the IC 727 states that the contract is awaiting the Division of Materials and Tests certification, several factors could be the cause of this but which are not the fault of this division. Each factor to be mentioned has been discussed in this chapter but not in this context. They are as follows:

- a) Discrepancy letters- If a work item quantity is found to be incorrect, it is the fault of the contractor or project engineer, not the Division of Materials and Tests unless this division lost a form. All of these discrepancy letters have to be cleared up prior to certification issuance.
- b) Failed tests- If a material sample fails a test and the Failure Committee has not yet discussed the matter, the delay is not the fault of the Division of Materials and Tests.
- c) Basis for Use Certifications- If the project engineer puts down an incorrect basis for use and a delay results, it is his fault, not the Division of Materials and Tests.
- d) District Office Materials' Laboratory certification- Even if the Division of Materials and Tests has all of its work done, it can not issue a certification until it receives the same from the District Office Materials' Laboratory. This again is not the fault of the Division of Materials and Tests.

All four of the factors discussed above help to decrease the percentage of contracts in which interest penalties were caused by the Division of Materials and Tests. This fact is reiterated in the Penalty History Analysis section (7.7) of the Data Analysis chapter. However, it should be remembered that prior to March 1977, the division's operations were much more inefficient than they are now. The division did cause a large share of the interest penalties but its improvements should decrease this percentage. Recommendations on how the Division of Materials and Tests could be further improved will be discussed in the next section.

5.6 Recommendations

Even though the efficiency of the Division of Materials and Tests was increased with the changes made in March 1977, there is still room for improvement. The following recommendations are offered for future consideration and possible implementation:

- a) Stop both distribution cycles- At present, the IT 611's are sent through the four stop cycle each month along with the preliminary IC 642 at the end of the job. The thousands of forms that travel through these cycles each year present many chances for lost or misplaced forms. Also, the work required to keep track of where the forms are and should be in the cycle is immeasurable. Therefore, it is recommended to keep all of the forms at one desk, namely that of the Assistant to the Office Engineer. He then would not have to keep track of where all the forms are since he would have them.

If he was given an assistant to help him, he could perform all of the work the four sections do now. This could save the State of Indiana money in salaries since it would be deleting unnecessary personnel.

- b) Issue the Division of Materials and Tests certification without having the District Office Materials' Laboratory certification- The researchers feel that the hold-up that occurs when there is a wait on this District Office certification is unnecessary. Even more unnecessary is the need for two separate material certifications. It seems as though every sample of every work item could be checked in the Division of Materials and Tests. Even if this drastic step is not taken, the need to wait on the District Office Materials' Laboratory certification is unjustified since when the Division of Materials and Tests issues its certification, it is certifying every piece of material on the job.
- c) Check all Manufacturer's certifications- At present, the number of manufacturing firms' certifications which are checked for accuracy is very low due to not having enough personnel. The State of Indiana is assuming that the test results from the manufacturers are valid in almost all cases. Tests by the Division of Materials and Tests have shown that mistakes are made by the manufacturers and results which they say meet the specifications really do not. Therefore, all manufacturer certifications should be checked by the Division of Materials and Tests' personnel, even if

more personnel are needed by this division.

- d) Computerize the paperwork procedure through the Division of Materials and Tests- Almost the entire checking procedure could be easily computerized. The computer could total up IT 611 work item quantities and make sure the quantities are equal to or greater than the IC 642 quantities. The computer could determine if the required number of sample tests were taken according to the work item quantities. Finally, the computer could check to see if the Basis for Use certifications are as required. For each of these three computerized activities, the computer would print out an error message when there is noncompliance to Indiana State Highway Commission specifications. At present, the computer prints out for project engineers test results of samples that have been sent in to the Division of Materials and Tests. The researchers feel the added computerization could greatly aid the paperwork aspect of this division.

Each of the above suggestions should help the final construction contract payment procedure in that each will increase its efficiency.

5.7 Summary

This chapter has shown the results of the researchers' discussions with Division of Materials and Tests personnel along with stating a few of their own opinions. The present procedure, greatly improved over the past, was laid out. Finally, it is felt that implementation of one or all of the recommendations could greatly expedite the payment process.

CHAPTER 6

RESULTS OF THE REVIEW OF THE INDIANA STATE HIGHWAY COMMISSION 1970
CONSTRUCTION RECORD GUIDE FOR ROAD, BRIDGE, MAINTENANCE, AND TRAFFIC
CONTRACTS

One of the primary objectives of this research study was to thoroughly review the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. It was prepared in 1970 and has not been updated since that time. The guide is used by the project engineer as a reference of how to complete the work item quantities for the contract he is supervising. During the Joint Highway Research Advisory Board meeting on December 1, 1976 in which the proposal for this research study was approved, it was stated by one of the Indiana State Highway Commission officials that it might be good for a layman like the researcher to study this book and propose improvements. Since the researcher has never been a project engineer for the State of Indiana and therefore has never prepared a final Construction Record utilizing this book, he felt that the best way for him to review it was to go through the guide page by page and see if he could follow the work item examples. The results of this review are interesting and appear in the following few paragraphs.

The first thing noticed by the researcher about the guide during its review was the number of mistakes it contains. These errors include numerical calculation errors, misspellings, and incorrect

transpositions of data from page to page. A listing of all of these mistakes can be found in Appendix C. These errata sheets should be issued to all project engineers so they can correct their Construction Record Guides. The project engineer completing the final construction contract payment procedure for the first time relies heavily upon this book. In order to compute some of his work item quantities, he has to follow the examples in the guide step by step. Examples with mathematical mistakes in them make it harder on the neophyte. He gets confused when his calculations which are correct give him one answer while the guide's calculations, which he assumes to be correct but are not, give him another. Therefore, a careful check of the next edition of the guide could prevent a lot of headaches.

The layout of the Construction Record Guide seems adequate. It is divided into several major topics such as Grading Items, Bridge Items, and Traffic Items. This type of organization provides for easy referencing by the project engineer.

The researcher's review of the guide resulted in no new recommendations for its improvement beyond those found in the interview chapters of this paper with both the project engineers and the District Review Officers (chapters 3 and 4). Each of those two chapters listed several improvements to the guide which will not be repeated here. However, it should be stated that the researchers feel that the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts is on the whole adequate and provides a good reference for both new and experienced project engineers. The guide does not inhibit the efficiency of

the final construction contract payment procedure process. As the Data Analysis chapter will show, the person using the Construction Record Guide is the primary reason for the problems with the payment process. The guide lays down the proper ways of computing the work item quantities, but getting the project engineers to compute them on time and correctly is another matter.

CHAPTER 7

DATA ANALYSIS

As was mentioned in the Objectives of the Study section (1.2), the data analysis of the final construction contract payment procedure encompasses all highway related construction contract data for Indiana since 1972. The reason for this is twofold. First, the 180 day payment statute was passed in 1972, so there would not be any contract penalties prior to that year. Secondly, the State of Indiana began compiling contract data using a computer in 1972. Therefore, it was much easier for the researchers to scan the computer printouts for data rather than to dig through the Indiana State Highway Commission's archives to find pertinent highway related construction contract data. A sample of the contract data issued by the State of Indiana is shown in the Computer Program Development section (7.1).

The data analysis covers a wide range of topics. All pertain to contract penalties but some look at the interest penalties from different viewpoints. The following are the sections of this Data Analysis chapter:

- 7.1 Computer Program Development
- 7.2 Penalty Breakdown by Year
- 7.3 Penalty Breakdown by Contract Type
- 7.4 Penalty Breakdown by Contract Duration

- 7.5 Penalty Breakdown by Geographic District
- 7.6 Penalty Breakdown by Project Engineer Type
- 7.7 Penalty History Analysis
- 7.8 Liquidated Damages Analysis

Each section will contain an analysis of the trends shown by the contract data along with pertinent tables or graphs of data. Whenever penalty totals in terms of dollars (\$) are expressed on the graphs, these sums will have a number in parentheses above them. This number signifies the number of contracts in which penalties were paid which make up that total amount. This allows for the computation of average penalties if it is so desired.

As will be noticed when the data is presented in tabular or graphic form, no penalties were paid during 1972 and 1973 and very few were paid in 1974. The reason for this fact has already been mentioned in the Justification for the Study section (1.1). When the Indiana General Assembly changed the contract payment statute in 1972 pertaining to the State of Indiana having 120 days to pay the contractor, they also decided that this new law could only be applied on highway related contracts for which bids on these contracts were received from possible contractors on or after March 1, 1972. In reviewing the Indiana State Highway Commission's computer print-outs of contract data, the majority of the contracts in which final payments were made in 1972, 1973, and 1974 were let prior to this date. Therefore, it is impossible for these contracts to be assessed an interest penalty, even if they were paid late by the State of Indiana. The tables and graphs might be misleading to some people.

However, it should be kept in mind that if the new statute had been made retroactive to for example 1970, the penalty totals for 1972, 1973, and 1974 would have shown a large increase over what they show now.

Finally, it should be remembered that the 1977 data points as expressed on the tables and graphs are projections. The actual data compilation ended with the August 31, 1977 computer printout from the Indiana State Highway Commission. This is because it was anticipated that this investigation would be completed by late November 1977. Since time was needed to analyze the data, it was felt by the researchers that cutting the data off three months prior to completion of the study would be feasible. Therefore, the 1977 projections are based on the trends shown by the data during the first eight months of 1977. The eight month dollar totals were multiplied by 1.5 to get the twelve month projections; percentages were not adjusted.

Following this introduction to the Data Analysis chapter are the eight sections which were listed earlier. The researchers know that the data could have been analyzed in other ways and that other variables could have been included during the data analysis besides contract type, project engineer type, year of payment, and geographical district. However, it was felt by the researchers that these four are representative of all others and that an analysis using them would arrive at similar conclusions in comparison to one in which other variables were considered.

7.1 Computer Program Development

The compilation of past and present highway contract data was made much easier through the usage of a computer program. When it was decided that a data analysis was necessary for the contract payment procedure, the fact that the contracts can be broken down in several ways quickly surfaced. These divisions of each contract are as follows:

- a) Penalty- yes or no.
- b) Contract type- Road, Bridge, Road-Traffic, Road-Surfacing, or Road-Maintenance.
- c) Year the contract payment procedure was completed- 1972, 1973, 1974, 1975, 1976, or 1977.
- d) Geographic district- Crawfordsville, Fort Wayne, Greenfield, LaPorte, Seymour, or Vincennes.
- e) Project engineer type- city, county, or state.

If one takes the product of the number of subdivisions in each division, it can be seen that there are 1080 possible types of contracts.

Therefore, it was quickly decided that the time it would take to write a computer program for this data would be very beneficial to the researchers.

With respect to contract data, the researchers were constrained by the fact that the Indianapolis Central Office has been compiling contract data only since 1972. This office releases a computer printout each month showing both the highway contracts which are in progress and those that have been completed during the year. It is from these printouts that the researcher derived the required

information in order to make a data analysis. A sample of the data received from Indianapolis can be seen on the next page in Figure 2. By referring to the headings at the top of the sample, one can easily ascertain what each section of the contract data sample refers to. From this data, the researchers extracted five contract breakdown divisions that they required for the computer program. This data was then placed on computer cards in the following format:

Columns 1-8:	Contract number
Columns 10-11:	Contract type
Column 13:	Project engineer type
Column 15:	Penalty- yes or no
Columns 17-24:	Penalty amount
Column 26:	Geographic district
Columns 28-29:	Reason for penalty
Column 31:	Year the contract payment procedure was completed

A coding system was devised for several of these data components in order to facilitate both programming and data handling. For the type of contract, the coding is as follows:

<u>Contract Type</u>	<u>Code</u>
Road	1
Bridge	2
Road-Traffic	3
Road— Surfacing	4
Road-Maintenance	5

The project engineers were coded as shown below:

<u>Project Engineer Type</u>	<u>Code</u>
City	1
County	2
State	3

The fact that there was a penalty on a contract is connoted by the number 1. The number 2 signified that there was no penalty.

The geographic districts were coded in the following manner:

<u>Geographic District</u>	<u>Code</u>
Crawfordsville	1
Fort Wayne	2
Greenfield	3
LaPorte	4
Seymour	5
Vincennes	6

The major reasons for penalties are coded as follows:

<u>Reason</u>	<u>Code</u>
No penalty	0
Project engineer turned in the Construction Record late	1
Late issuance of the Division of Materials and Tests certification	2
Project engineer turned in the Construction Record incomplete or with revisions required	3
Need the M-39 from the contractor	4
Need an approved IC 626 from the Central Office or the contractor	5

<u>Reason</u>	<u>Code</u>
Lengthy check in the district office	6
Late issuance of the District Office Materials' Laboratory certification	7
Late issuance of the supplemental IT 611's	8
Late receipt of a sign certification letter	9
Lengthy processing by IBM	10
Delay at the Central Office	11
Late issuance of a core report	12
Contractor protesting work day charges or approval of extension time	13
Holding for laboratory numbers	14
Awaiting FHWA approval for a time extension	15
Awaiting IC 115 (Extra Work Agreement)	16
Miscellaneous or other	17

The year the contract payment procedure was completed was coded according to the last digit in the year. For example, the code for a contract completed and paid in 1976 is 6. It should be noted that this coding system would have to be altered slightly if the computer analysis was carried out in the 1980's due to the repetition of unit digits for each decade. The program is set up so that the year code can easily be changed into a two digit number by altering one format statement.

The actual computer program was written by the researchers in the Fortran language. It makes use of several "IF Statements" which facilitate the required branching that is needed to differentiate between the 1080 possible types of contracts. The general layout of the computer program can be seen in Figure 3 on the next page which is the Computer Program Flowchart. A copy of the actual computer program is illustrated in Appendix A.

Output for the computer program consists of a number of tables. The first table lists the contracts for the year in which a penalty occurred along with the actual penalty amount. At the bottom of this table is the total penalty amount paid by the State for the year. This first table is followed by five sets of tables, each of which contains data for a certain contract type. Each of these five sets of tables contains the following information for the year:

- a) The percentage of contracts of a certain type in which a penalty was paid.
- b) A breakdown by districts of the percentage of penalties paid for a certain contract type.
- c) A breakdown by districts with respect to penalty percentages versus project engineer type for a certain type of contract.
- d) The total penalty paid for a certain contract type.
- e) A breakdown by districts of penalty amounts versus project engineer type for a certain type of contract.
- f) A breakdown by project engineer type of the total penalty amounts paid for a certain type of contract.

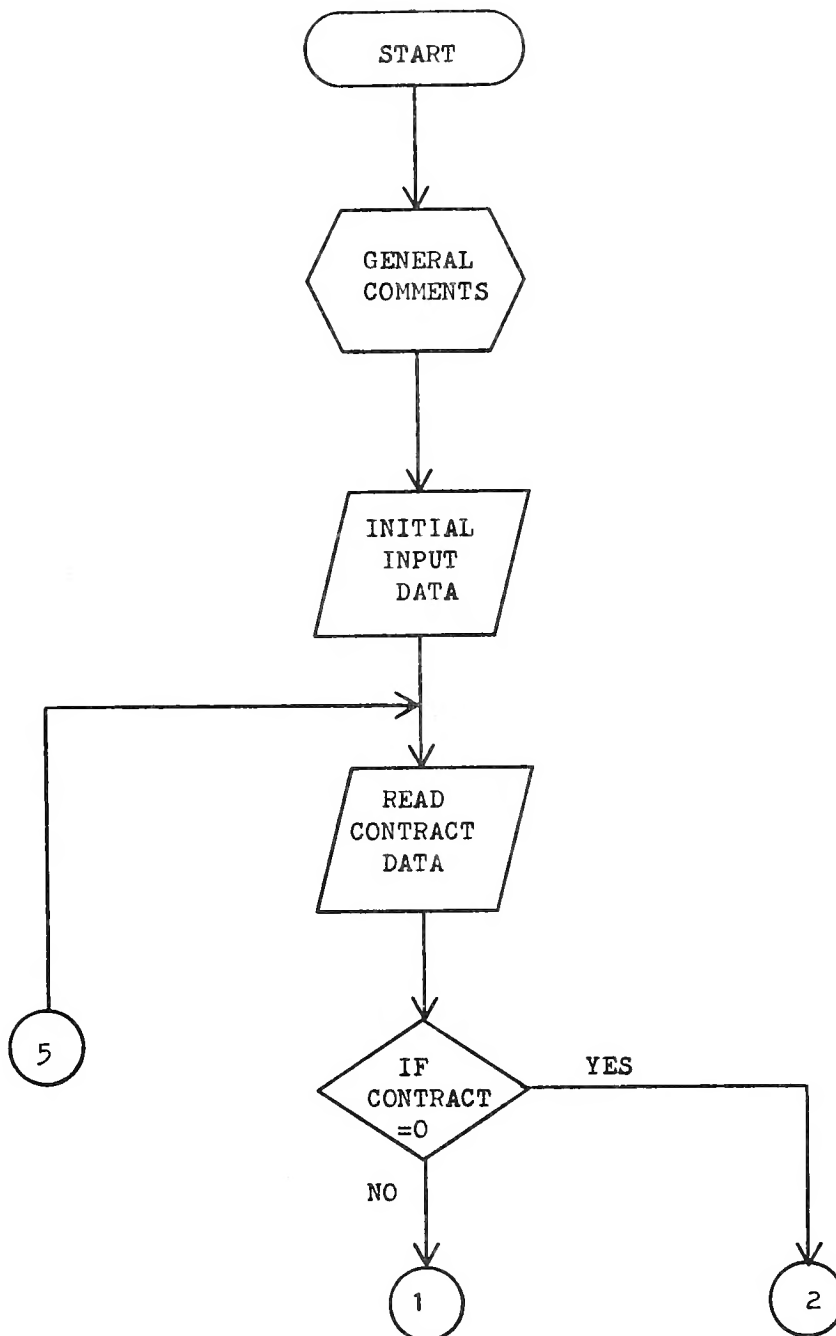


Figure 3

COMPUTER PROGRAM FLOWCHART

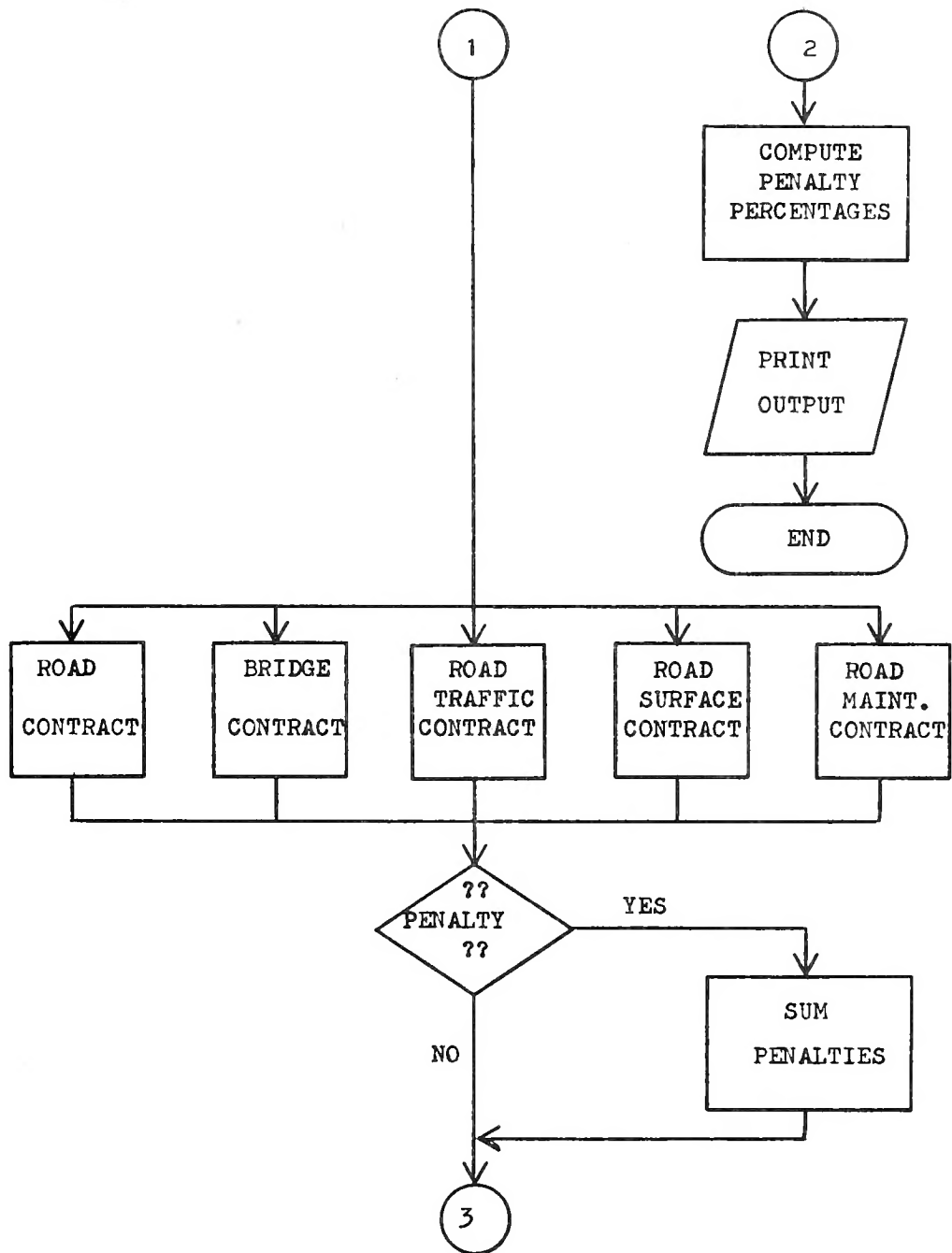


Figure 3, cont.

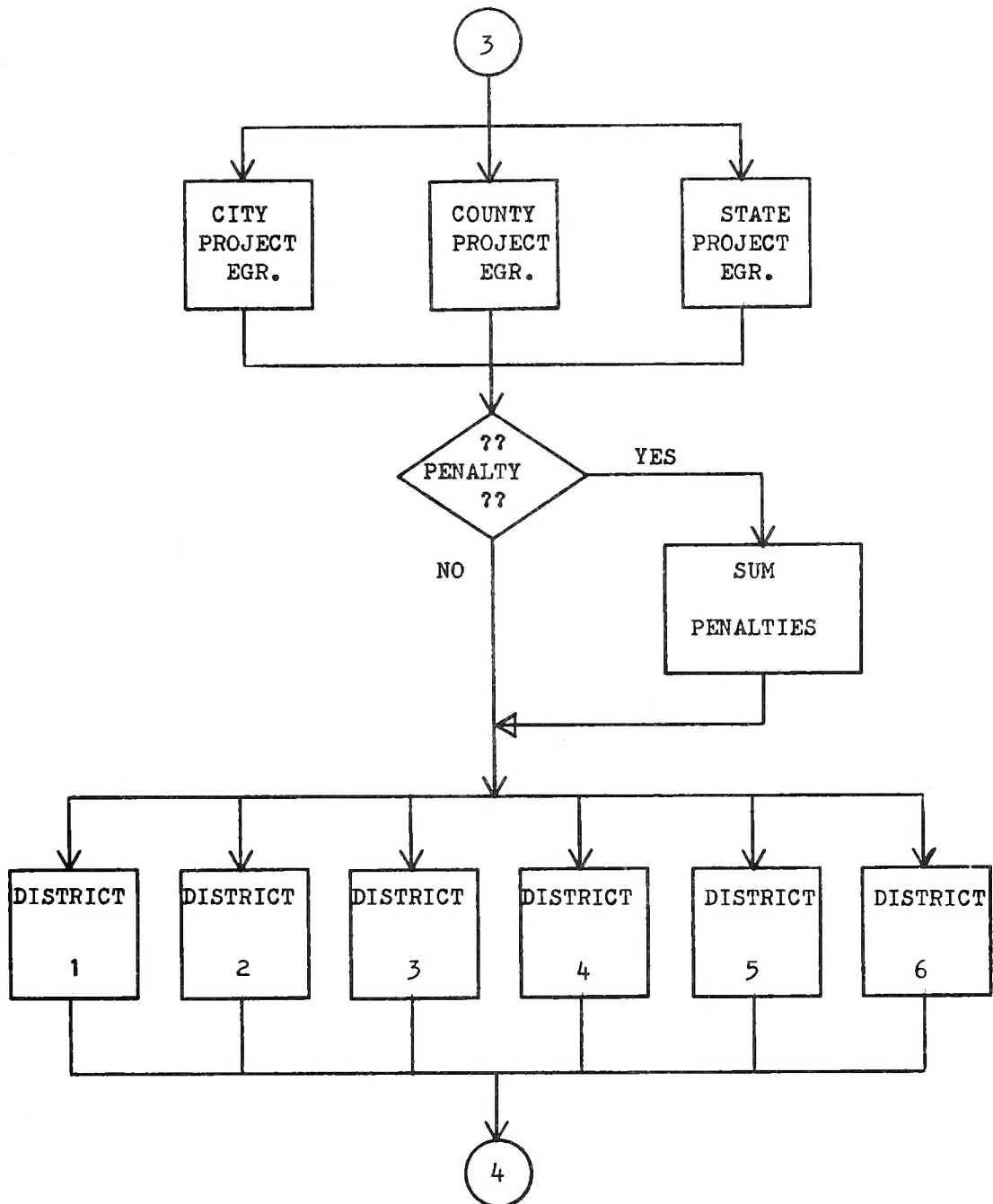


Figure 3, cont.

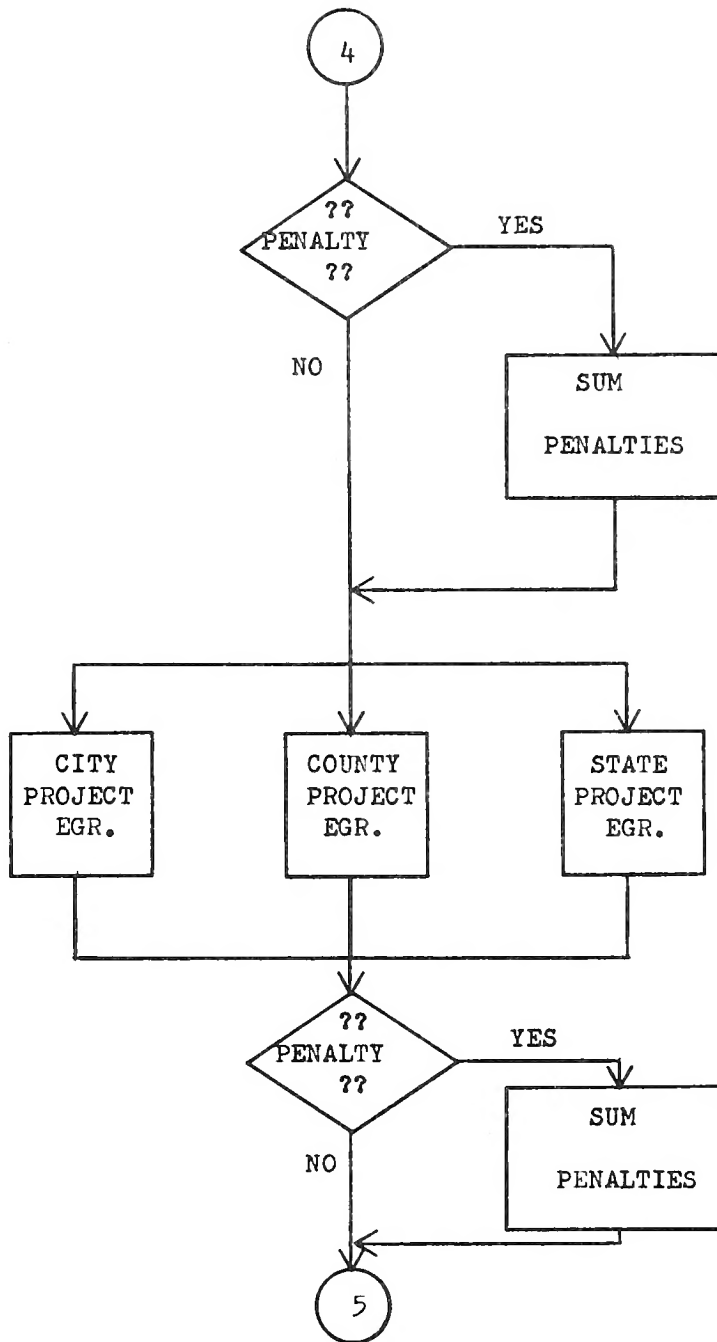


Figure 3, cont.

An example of the output is shown in Appendix B. This output is for the 1976 data and its content should be self explanatory.

The computer program that was developed for the data analysis greatly reduced the tedious job of tabulating data. The program was written so that it has to be run a separate time for each year of data. This allows for unlimited future use of the program by the State of Indiana except for a minor format alteration in later years for the contract year coding system. Also, the program provides for each data card to contain the required information for only one contract. This prevents mistakes in that contract data cannot be mixed up on cards as when two or more data points are on a single card. Finally, the program format was developed so that if future data divisions or methods of analysis are desired, they can be easily added by changing only a few cards. This versatility makes this computer program a valuable data analysis tool.

7.2 Penalty Breakdown by Year

One of the methods of analyzing the contract data was by contract year. The contract year is that year when the final payment was made to the contractor by the Indiana State Highway Commission whether an interest penalty occurred or not. The plot of Total Penalty versus Year can be seen in Figure 4. This figure clearly shows that from 1972 through 1977, the total penalty dollar amount increased dramatically. Also on this plot can be seen the increase in the number of contracts in which penalties occurred except for the same values in 1976 and 1977.

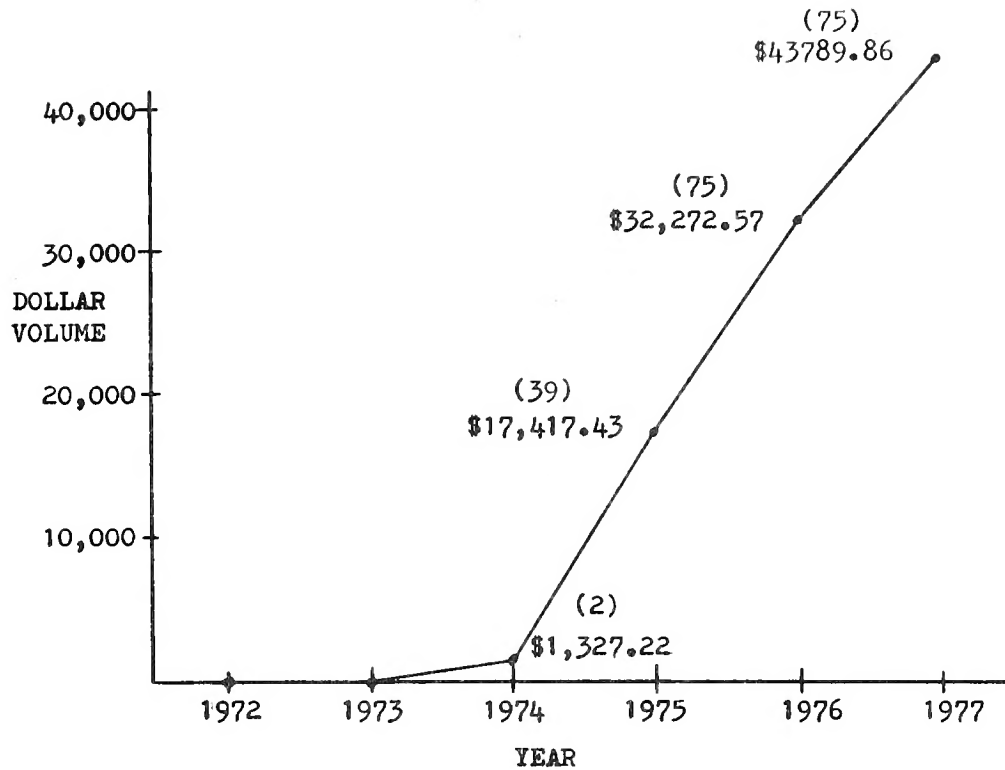


Figure 4

TOTAL PENALTY VERSUS YEAR

Table 2

PERCENT OF CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	119	0	0 %
1973	153	0	0 %
1974	163	2	1 %
1975	279	39	14 %
1976	355	75	21 %
1977	359	75	20 %

From the data compilation, it was known that from 1972 through 1977, the number of contracts let by the State of Indiana for highway related construction increased. Because of this, one might say that the increasing penalty amounts were due only to the increased number of contracts being performed; however, this is not the case. If one looks at the percentage of contracts in which penalties were paid each year with this percentage being based on the number of contracts in which penalties occurred divided by the total number of contracts in which final payments were made, it can be observed that this percentage increases from 1972 through 1976 and decreases by only one percent in 1977. Table 2, entitled Percent of Contracts With Penalties versus Year, shows this trend in penalty percentages. Therefore, the data shows that the State is paying fewer and fewer of its contracts on time.

The 1977 projections are based upon the following eight month data:

- a) Total Penalty- \$29193.24
- b) Number of Contracts with Penalties- 50
- c) Total Number of Contracts- 239

7.3 Penalty Breakdown by Contract Type

As was shown in the Computer Program Development section (7.1), there are five types of highway related construction contracts in the State of Indiana. They are the Road contract, the Bridge contract, the Road-Traffic contract, the Road-Surfacing contract, and the Road-Maintenance contract. An example of each along with its appropriate Indiana State Highway Commission coding symbol are as follows:

<u>CONTRACT TYPE</u>	<u>CODING SYMBOL</u>	<u>EXAMPLE</u>
Road	R	Continuous reinforced concrete paving on I-65
Bridge	B	Bridge erection over the Wabash River
Road-Traffic	RT	Installation of traffic signals in Lafayette, Indiana
Road-Surfacing	RS	Bituminous resurfacing on Route 38
Road-Maintenance	RM	Bridge painting in Tippecanoe county

When analyzing the 1972 through 1976 contract penalty data based on contract type, it again becomes apparent that the State of Indiana is making fewer final payments of its highway related contracts on time. Figures 5 through 9 are graphs of the total penalty for each contract type versus year. Tables 3 through 7 are tabulations of contract penalty percentage data for each type. It can be seen from the tables that the percentage of contracts up to 1976 in which penalties are being paid is increasing for each contract type except in Table 4 which pertains to Bridge contracts. This penalty percentage for bridges decreased slightly (2%) from 1975 to 1976. However, the other four contract types show a noticeable penalty percentage increase from year to year. The 1977 data, however, shows some improvement in that penalty dollar totals decreased for the Bridge, Road-Traffic, and Road-Maintenance contracts. Penalty percentages also decreased for the Road, Road-Traffic, Road Surfacing, and Road-Maintenance contracts.

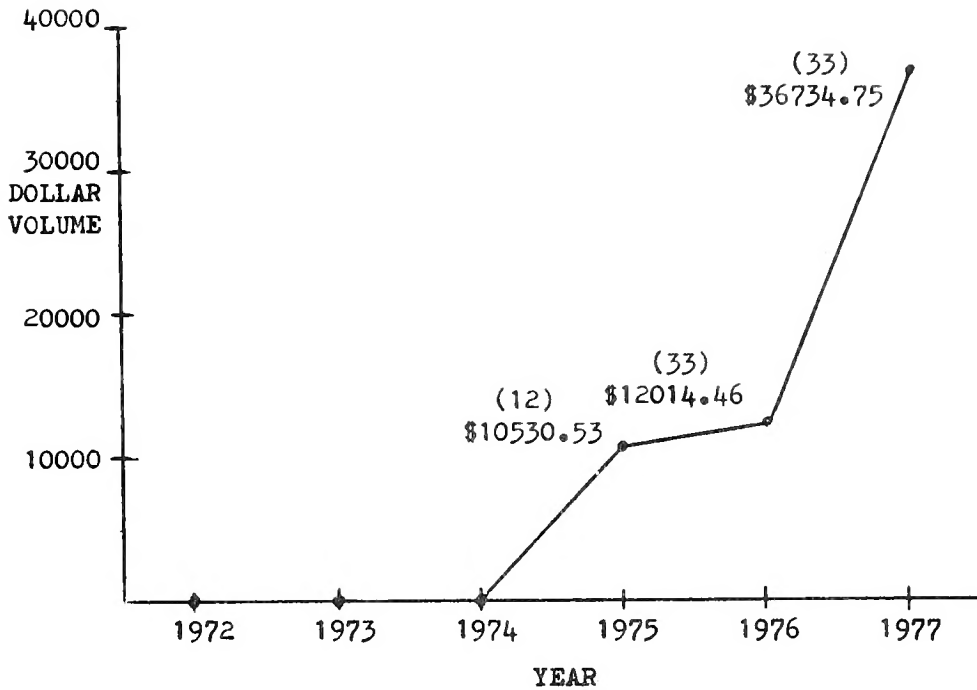


Figure 5

TOTAL ROAD PENALTY VERSUS YEAR

Table 3

PERCENT OF ROAD CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	60	0	0 %
1973	58	0	0 %
1974	52	0	0 %
1975	64	12	19 %
1976	94	33	35 %
1977	95	33	34 %

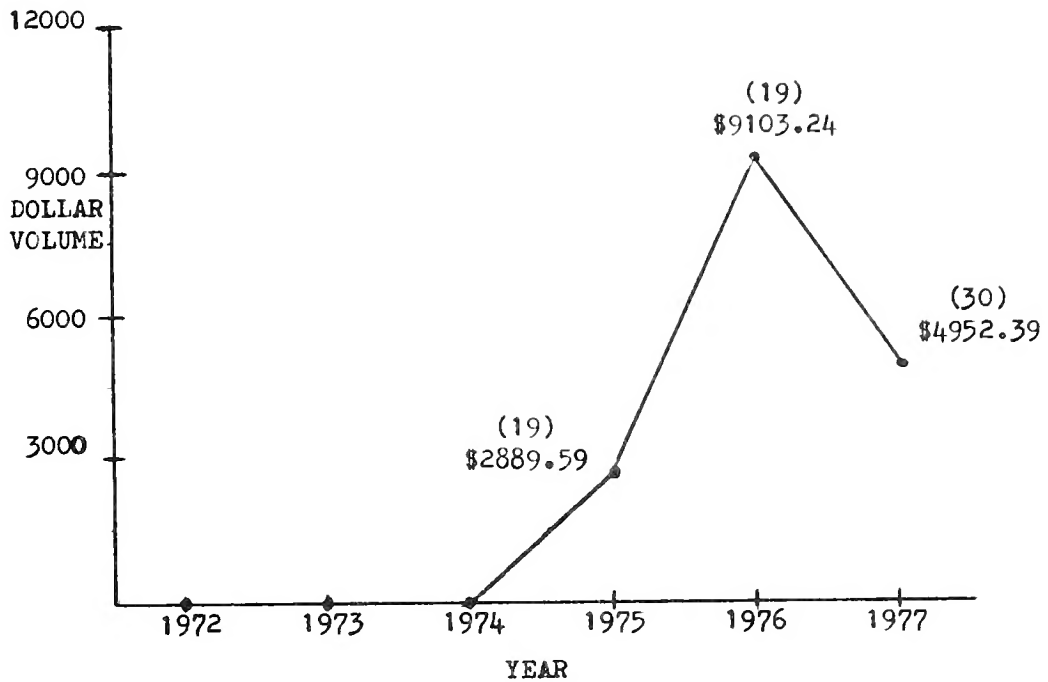


Figure 6

TOTAL BRIDGE PENALTY VERSUS YEAR

Table 4

PERCENT OF BRIDGE CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	54	0	0 %
1973	86	0	0 %
1974	68	0	0 %
1975	94	19	20 %
1976	107	19	18 %
1977	131	30	22 %

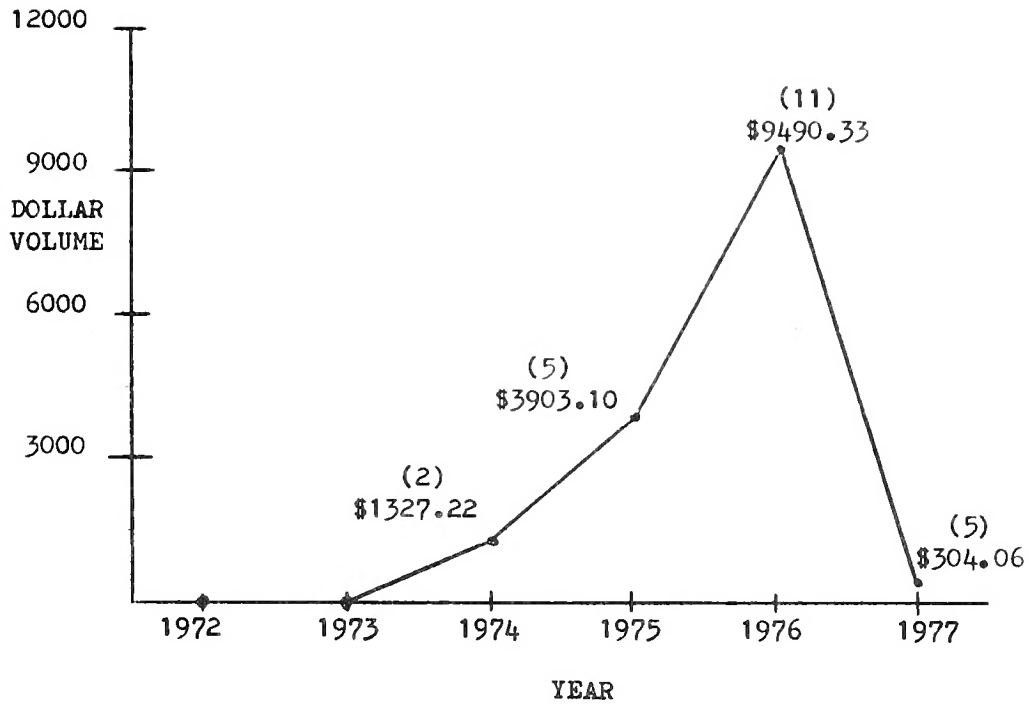


Figure 7

TOTAL ROAD*TRAFFIC PENALTY VERSUS YEAR

Table 5

PERCENT OF ROAD*TRAFFIC CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	5	0	0 %
1973	9	0	0 %
1974	17	2	12 %
1975	23	5	22 %
1976	36	11	31 %
1977	23	5	20 %

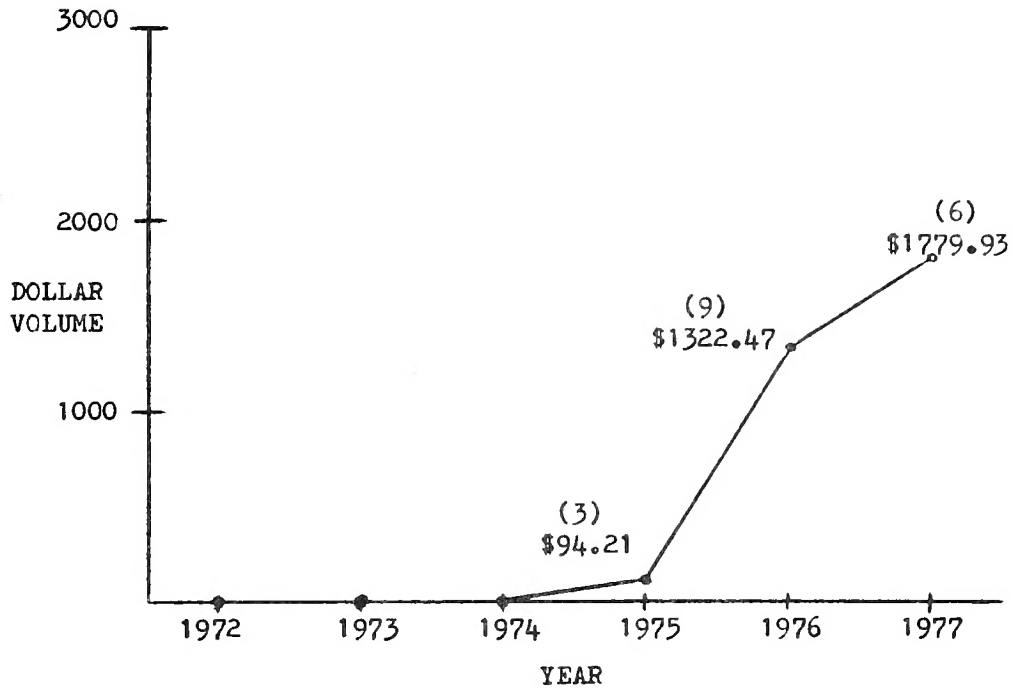


Figure 8

TOTAL ROAD*SURFACING PENALTY VERSUS YEAR

Table 6

PERCENT OF ROAD*SURFACING CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	0	0	0 %
1973	0	0	0 %
1974	23	0	0 %
1975	75	3	4 %
1976	76	9	12 %
1977	83	6	7 %

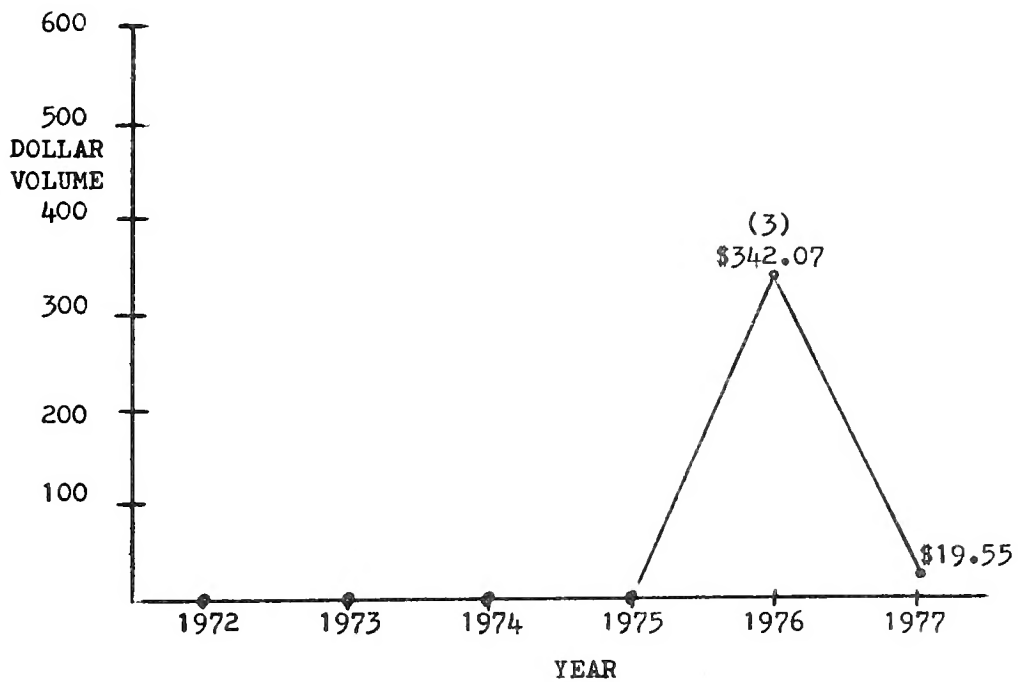


Figure 9

TOTAL ROAD*MAINTENANCE PENALTY VERSUS YEAR

Table 7

PERCENT OF ROAD*MAINTENANCE CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	0	0	0 %
1973	0	0	0 %
1974	3	0	0 %
1975	23	0	0 %
1976	42	3	7 %
1977	29	2	5 %



The tabulations also show that Road contracts provide the highest chance of an interest penalty occurring. This percentage (35% in 1976) for Road contracts is closely followed by the percentage for Road-Traffic contracts (31% in 1976). The 1977 data illustrates this high percentage for Road contracts but they are followed this time by Bridge contracts. The reason why the Road contract penalty percentage is the highest for all contract types should be apparent. Road contracts entail many more work items than the other four types of contracts. Therefore, the typical Road contract provides for more paperwork for the project engineer of the contract, which leads to more needed checking by both the District Review Officer and the material certification personnel. The data then bears out the feeling of the researchers and the Indiana State Highway Commission officers that the hardest type of highway related construction contract for which a final payment will be made to the contractor on time is the Road contract. This opinion is also supported when looking at Figures 5 through 9 for the 1972 through 1977 contract data. For 1975, 1976, and 1977, the Road contract penalty dollar totals are much greater than any of the other four types of contracts.

When looking at the five graphs, it should also be apparent that all are climbing from 1972 through 1976. This helps to reinforce the fact that things are getting worse for the final construction contract payment procedure. For 1977, three of the five show a fall but the sharp increase in Road contract penalties outweighs all of the decreases.

From the analysis of the contract data based on contract type for 1972 through 1977, the researchers feel that project engineer experience should be taken into account when assigning contracts. It should be obvious that based on the difficulty of completing the contract's Construction Record, the more experienced project engineer should be given the Road contracts. The researchers feel that if the project engineer is unable to complete the Construction Record on time and satisfactorily, this insufficiency probably carries over into his daily work. Another study of this type might be to investigate the project engineer's ability to complete the Construction Record on time with the final quality of his project. This type of analysis might prove interesting to the State of Indiana.

The following eight month data is the basis for the 1977 projections shown on the tables and figures for the contract types:

a) Total Road contract penalty	- \$24489.83
b) Total Bridge contract penalty	- \$5301.59
c) Total Road-Traffic contract penalty	- \$202.17
d) Total Road-Surfacing contract penalty	- \$1186.62
e) Total Road-Maintenance contract penalty	- \$13.03
f) Total number of Road contracts	- 63
g) Total number of Bridge contracts	- 87
h) Total number of Road-Traffic contracts	- 15
i) Total number of Road-Surfacing contracts	- 55
j) Total number of Road-Maintenance contracts	- 19
k) Total number of Road contracts with penalties	- 22
l) Total number of Bridge contracts with penalties	- 20



- m) Total number of Road-Traffic contracts with penalties - 3
- n) Total number of Road-Surfacing contracts with penalties - 4
- o) Total number of Road-Maintenance contracts with penalties - 1

7.4 Penalty Breakdown by Contract Duration

Another way of analyzing the highway related contract data was by contract duration. Contract duration is the number of working days or calendar days that is allowed to the contractor by the State of Indiana to complete his work. Most contracts are usually issued on the work day basis due to holidays occurring during the anticipated work span or the possibility of inclement weather during the project. For this analysis, the researchers used the Indiana State Highway Commission contractual data which contains both the contract letting date and the number of working days allowed the contractor. A few of the contracts gave a completion date instead of the number of work days allowed but the number of work days between starting and finishing can be easily converted from the calendar days. For this analysis, considering Saturdays and Sundays but not considering legal holidays, it is assumed that there are 260 working days in a calendar year. Therefore, the contract duration breakdowns were by 130 working days which corresponds to six months of calendar days. It should be remembered that only those contracts in which interest penalties occurred were analyzed. Table 8 shows for each contract

Table 8

PENALTY TOTALS AND PERCENTAGES VERSUS CONTRACT DURATION

DURATION	YEAR			
	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>
0-130 WD	\$1327.22 (2) 100%	\$9659.25 (24) 62%	\$9015.26 (36) 48%	\$8508.53 (35) 46%
131-260 WD	\$0.00 (0) 0%	\$7697.28 (14) 36%	\$15064.12 (36) 48%	\$32668.17 (30) 39%
261-390 WD	\$0.00 (0) 0%	\$60.90 (1) 3%	\$879.43 (1) 1%	\$1582.86 (8) 11%
391-520 WD	\$0.00 (0) 0%	\$0.00 (0) 0%	\$0.00 (0) 0%	\$1030.31 (3) 4%
521-650 WD	\$0.00 (0) 0%	\$0.00 (0) 0%	\$7313.76 (2) 3%	\$0.00 (0) 0%
≥ 651 WD	\$0.00 (0) 0%	\$0.00 (0) 0%	\$0.00 (0) 0%	\$0.00 (0) 0%

NOTE: Data for 1972 and 1973 is not included on this table since no interest penalties occurred during those two years.

duration breakdown, the penalty total amount, number of contracts making up this amount, and percentage of the total number of contracts with penalties for the year.

For the 1974 through 1977 data, it can be seen from Table 8 that the short contracts, namely those equal to or less than one year in duration, make up the highest percentage of contracts with penalties. This seems to contradict what is normally believed by Indiana State Highway Commission officials. They feel and the researchers concur in this belief that the short contracts normally have fewer work items and as a result should have less paperwork for the Construction Record connected to them. Therefore, they should present a smaller chance for possible interest penalties. However, as can be seen from the data on Table 8, this belief is soundly contradicted. The only reason the researchers can come up with for this is that the State of Indiana lets a higher percentage of short duration contracts in comparison to long contracts and because of this, more of the contracts with penalties are of short duration.

To arrive at the 1977 data on Table 8, the following eight month data was used:

- | | |
|---|------|
| a) Number of 1977 penalty contracts
of 0-130 working days duration | - 23 |
| b) Number of 1977 penalty contracts
of 131-260 working days duration | - 20 |
| c) Number of 1977 penalty contracts
of 261-390 working days duration | - 5 |
| d) Number of 1977 penalty contracts
of 391-520 working days duration | - 2 |

e) Number of 1977 penalty contracts of 521-650 working days duration	- 0
f) Number of 1977 penalty contracts of equal to or greater than 651 working days duration	- 0
g) Penalty total of 1977 contracts of 0-130 working days duration	- \$5672.35
h) Penalty total of 1977 contracts of 131-260 working days duration	- \$21778.78
i) Penalty total of 1977 contracts of 261-390 working days duration	- \$1055.24
j) Penalty total of 1977 contracts of 391-520 working days duration	- \$686.87
k) Penalty total of 1977 contracts of 521-650 working days duration	- \$0.00
l) Penalty total of 1977 contracts of equal to or greater than 651 working days duration	- \$0.00

7.5 Penalty Breakdown by Geographic District

The next way the contractual data was analyzed was by geographic district. As has been stated previously, the State of Indiana is comprised of six highway districts. Each is run by a separate district engineer and each has a District Review Officer who checks the Construction Records and who tries to keep the interest penalties as low as possible. Each district also performs all five types of contracts. Therefore, the researchers thought it might be interesting to compare districts as to their ability to pay the highway related construction contracts on time.

The data was analyzed by district in three ways. They were by penalty totals, by penalty percentage, and by the number of construction personnel in the district. The results of the first two

methods will be discussed in the following two paragraphs and then they will be followed by the construction personnel analysis.

Tables 9 through 14 show for each geographic district its interest penalty total for each year along with its penalty percentage. The penalty percentage was calculated by dividing the number of contracts in which penalties occurred by the total number of contracts in which final payment was made during the year. As can be seen on Table 11, the Greenfield district has the highest penalty total along with the highest penalty percentage for each of the years 1975, 1976, and 1977. The other five districts are not even close in their penalty percentages when compared to the Greenfield district. Another interesting result of the six tables is that they show that the penalty percentages increased each year for every district until the 1977 data where all but the Seymour district decreased. Also, it should be pointed out that the LaPorte district was the best district in terms of low interest penalties and percentages up through 1976. It was beaten by 2% in 1977 by the Vincennes district. These six tables show that the State of Indiana ought to be investigating its personnel in the Greenfield district to see why and because of whom the inefficiencies occur.

The 1977 data for district total penalties and percentages is based on the eight month data listed below:

- a) Penalty total in the Crawfordsville district - \$9467.18
- b) Penalty total in the Fort Wayne district - \$11468.70
- c) Penalty total in the Greenfield district - \$3268.17
- d) Penalty total in the LaPorte district - \$1334.80

Table 9

CRAWFORDSVILLE DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	21	0	0%
1973	\$0.00	28	0	0%
1974	\$0.00	11	0	0%
1975	\$560.63	48	7	15%
1976	\$2996.25	43	12	28%
1977	\$14200.77	56	15	27%

Table 10

FT. WAYNE DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	15	0	0%
1973	\$0.00	19	0	0%
1974	\$0.00	23	0	0%
1975	\$2545.59	36	4	11%
1976	\$2913.46	60	14	23%
1977	\$17203.05	45	9	20%

Table 11

GREENFIELD DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	25	0	0%
1973	\$0.00	35	0	0%
1974	\$1259.31	25	1	4%
1975	\$6526.66	56	14	25%
1976	\$19366.54	57	24	42%
1977	\$4902.26	89	29	32%

Table 12

LA PORTE DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	21	0	0%
1973	\$0.00	21	0	0%
1974	\$0.00	34	0	0%
1975	\$64.30	34	2	6%
1976	\$728.00	65	8	12%
1977	\$2002.23	41	3	7%

Table 13

SEYMOUR DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	19	0	0%
1973	\$0.00	33	0	0%
1974	\$0.00	35	0	0%
1975	\$6089.51	62	8	13%
1976	\$4621.83	65	10	15%
1977	\$5290.58	65	17	26%

Table 14

VINCENNES DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	18	0	0%
1973	\$0.00	17	0	0%
1974	\$67.91	35	1	3%
1975	\$1630.84	43	4	9%
1976	\$1646.49	65	7	11%
1977	\$190.98	65	3	5%

e) Penalty total in the Seymour district	- \$3527.09
f) Penalty total in the Vincennes district	- \$127.32
g) Total number of contracts paid and the number with penalties in the Crawfordsville district	- 37,10
h) Total number of contracts paid and the number with penalties in the Fort Wayne district	- 30,6
i) Total number of contracts paid and the number with penalties in the Greenfield district	- 59,19
j) Total number of contracts paid and the number with penalties in the LaPorte district	- 27,2
k) Total number of contracts paid and the number with penalties in the Seymour district	- 43,11
l) Total number of contracts paid and the number with penalties in the Vincennes district	- 43,2

The third way of analyzing the highway related construction contract data by district is to consider the number of construction personnel working for the district each year. The Indiana State Highway Commission considers anyone with a Function 90 job code as a member of its construction personnel. All six geographic districts in the State of Indiana vary as to the number of construction personnel working in it. Indiana State Highway Commission officials felt that there might be a correlation between the number of State men working on the contracts and the total interest penalty for the contracts. They thought that the districts with fewer construction personnel would show the highest penalty amounts.

In order to investigate this opinion, the researchers had to get personnel data from the Indiana State Highway Commission's Personnel Office in Indianapolis. This office compiled the totals of all of the Function 90 personnel for each district for 1974, 1975, 1976, and up through August 31, 1977. This data can be seen on Tables 15 through 18.

Personnel data for 1972 and 1973 was not compiled since no penalties occurred those two years. Since all penalty totals for each district are based on the complete year, the researchers felt that it would be best to average the twelve monthly totals for each district to get a representative total for the year. These averages can be seen on the bottom row of each table.

In order to compare the geographic districts with respect to the number of construction men working in each district, the district interest penalty total for a year was divided by the average number of construction personnel working in that district during the year. The results of these calculations can be seen on Table 19. This table shows that in terms of dollars of interest penalty per construction man, the Greenfield district is the worst for years 1974 through 1976. This correlates with the data presented in the first part of this section. However, the Fort Wayne district is the worst in 1977 due to having a contract with an interest penalty over \$10000. This data also disproves the opinion of the Indiana State Highway Commission officials that those districts with fewer construction men would show a higher interest penalty cost per man. As can be seen from the 1975 and 1976 data on Table 19, the LaPorte district had

Table 15

NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1974

	DISTRICT					
	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LA PORTE</u>	<u>SEYMOUR</u>	<u>VINCENNES</u>
JAN	101	75	142	88	189	174
FEB	100	72	142	86	187	174
MAR	97	72	142	87	185	172
APR	94	71	142	87	183	165
MAY	97	74	154	83	179	172
JUNE	108	99	157	88	187	174
JULY	108	115	207	89	208	193
AUG	120	118	209	88	211	192
SEPT	94	80	156	82	172	150
OCT	99	85	157	76	169	148
NOV	103	88	159	75	168	161
DEC	101	84	157	74	167	150
<u>AVG</u>	<u>102</u>	<u>86</u>	<u>160</u>	<u>84</u>	<u>184</u>	<u>169</u>

Table 16

NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1975

	DISTRICT					
	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LAPORTE</u>	<u>SEYMOUR</u>	<u>VINCENNES</u>
JAN	100	85	157	75	182	149
FEB	97	86	152	75	181	151
MAR	98	86	148	74	177	150
APR	102	87	148	74	175	151
MAY	114	88	181	73	178	179
JUNE	113	108	194	74	185	187
JULY	116	120	224	74	200	184
AUG	122	119	231	78	198	186
SEPT	102	86	165	73	170	145
OCT	113	85	163	73	170	148
NOV	113	85	165	73	170	149
DEC	114	84	168	75	176	156
<u>AVG</u>	<u>109</u>	<u>93</u>	<u>175</u>	<u>74</u>	<u>180</u>	<u>161</u>

Table 17

NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1976

	DISTRICT					
	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LA PORTE</u>	<u>SEYMOUR</u>	<u>VINCENNES</u>
JAN	115	84	166	74	176	155
FEB	---	--	---	--	---	---
MAR	114	84	163	73	175	154
APR	111	84	164	74	174	155
MAY	115	87	183	74	176	195
JUNE	120	103	185	79	181	192
JULY	131	107	193	79	193	191
AUG	130	128	192	74	197	186
SEPT	116	86	165	74	165	152
OCT	115	86	162	74	163	151
NOV	115	86	157	74	164	151
DEC	125	86	151	75	162	151
<u>AVG</u>	<u>119</u>	<u>93</u>	<u>171</u>	<u>75</u>	<u>175</u>	<u>167</u>

Table 18

NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1977

DISTRICT

	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LA PORTE</u>	<u>SEYMOUR</u>	<u>VINCENNES</u>
JAN	123	85	149	75	160	146
FEB	123	85	146	75	160	145
MAR	122	85	146	74	160	142
APR	121	85	144	73	156	143
MAY	120	84	142	72	157	141
JUNE	157	130	161	87	159	145
JULY	158	130	160	87	158	141
AUG	152	126	167	85	157	143
<u>AVG</u>	<u>135</u>	<u>101</u>	<u>152</u>	<u>79</u>	<u>158</u>	<u>143</u>

Table 19

INTEREST PENALTY DOLLARS PER CONSTRUCTION MAN

	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>
CRAWFORDSVILLE	\$0.00	\$5.14	\$25.18	\$105.19
FT. WAYNE	\$0.00	\$27.37	\$31.33	\$170.33
GREENFIELD	\$7.87	\$37.30	\$113.25	\$32.25
LA PORTE	\$0.00	\$0.87	\$9.71	\$25.34
SEYMOUR	\$0.00	\$33.83	\$26.41	\$33.48
VINCENNES	\$0.40	\$10.13	\$9.86	\$1.34

the lowest interest penalty per man while it also had the lowest average number of construction men working during the year. Therefore, the data shows that a high number of construction personnel does not lead to a low interest penalty average.

7.6 Penalty Breakdown by Project Engineer Type

Three types of project engineers participate in the final construction contract payment procedure-- namely, city, county, and state. Each is expected to complete a Construction Record for his project. It was mentioned by several Indiana State Highway Commission officers that they felt that their state project engineers were doing a much better job of completing the Construction Record on time in comparison to both city and county project engineers. It should be explained here that the city and county project engineers are not employed by the State of Indiana; they are supervising a project built in their city or county for their city or county government. Because of this, they usually have other duties to attend to for the city or county while they are at the same time supervising a project. Also, since they do not supervise a project all of the time, their experience in filling out Construction Records would be naturally less than that of the State of Indiana project engineer. With these thoughts in mind, the highway related contract data was analyzed according to project engineer type.

Tables 20 through 23 are tabulations of project engineer penalty percentages for 1974 through 1977. The two columns under each of the three types of engineers signify the number of contracts with penalties and the total number of contracts paid throughout the year.

Table 20

1974 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

CONTRACT TYPE	CITY		COUNTY		STATE	
	PENALTY	TOTAL	PENALTY	TOTAL	PENALTY	TOTAL
ROAD	0	0	0	3	0	49
BRIDGE	0	0	0	11	0	57
ROAD- TRAFFIC	2	9	0	0	0	8
ROAD- SURFACING	0	0	0	0	0	23
ROAD- MAINTENANCE	0	0	0	0	0	3
TOTALS	2	9	0	14	0	140
PERCENTAGE	22%		0%		0%	

Table 21

1975 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

CONTRACT TYPE	CITY		COUNTY		STATE	
	PENALTY	TOTAL	PENALTY	TOTAL	PENALTY	TOTAL
ROAD	0	0	1	4	11	60
BRIDGE	1	1	4	14	14	79
ROAD- TRAFFIC	1	13	0	0	4	10
ROAD- SURFACING	0	0	0	0	3	75
ROAD- MAINTENANCE	0	0	0	0	0	23
TOTALS	2	14	5	18	32	247
PERCENTAGE	14%		28%		13%	

Table 22

1976 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

CONTRACT TYPE	CITY		COUNTY		STATE	
	PENALTY	TOTAL	PENALTY	TOTAL	PENALTY	TOTAL
ROAD	6	11	1	3	26	80
BRIDGE	0	0	4	19	15	88
ROAD- TRAFFIC	8	11	0	0	3	25
ROAD- SURFACING	0	0	0	0	9	76
ROAD- MAINTENANCE	0	0	0	0	3	42
TOTALS	14	22	5	22	56	311
PERCENTAGE	64%		23%		18%	

Table 23

1977 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

CONTRACT TYPE	CITY		COUNTY		STATE	
	PENALTY	TOTAL	PENALTY	TOTAL	PENALTY	TOTAL
ROAD	3	6	5	5	26	84
BRIDGE	5	11	5	14	21	107
ROAD- TRAFFIC	3	5	0	0	2	18
ROAD- SURFACING	0	0	0	0	6	83
ROAD- MAINTENANCE	0	0	0	0	2	29
TOTALS	11	22	10	19	57	321
PERCENTAGE	50%		53%		18%	

At the bottom of each table are percentages which are the portion of the total number of contracts supervised by a certain project engineer type in which a penalty occurred. As can be seen for 1974, 1975, 1976, and 1977, the city and county project engineers caused a higher percentage of penalties than their State of Indiana counterparts. Therefore, the data agrees with the Indiana State Highway Commission officials' opinions. This data brings up again that it might be a good idea for the State of Indiana to have a meeting with its project engineers to discuss the proper procedure in filling out the Construction Record. It seems as though this could only lower the penalty percentages along with decreasing the penalty amount paid to the contractors each year.

Table 23 shows the projected 1977 project engineer penalty percentage data. It is based on the eight month data shown below:

- a) Total number of city, county, and state project engineer Road contracts - 4,3,56
- b) Total number of city, county, and state project engineer Bridge contracts - 7,9,71
- c) Total number of city, county, and state project engineer Road-Traffic contracts - 3,0,12
- d) Total number of city, county, and state project engineer Road-Surfacing contracts - 0,0,55
- e) Total number of city, county, and state project engineer Road-Maintenance contracts - 0,0,19
- f) Number of city, county, and state project engineer Road contracts with penalties - 2,3,17
- g) Number of city, county, and state project engineer Bridge contracts with penalties - 3,3,14
- h) Number of city, county, and state project engineer Road-Traffic contracts with penalties - 2,0,1

- i) Number of city, county, and state project engineer Road-Surfacing contracts with penalties - 0,0,4
- j) Number of city, county, and state project engineer Road-Maintenance contracts with penalties. - 0,0,1

7.7 Penalty History Analysis

Probably the most important section of the Data Analysis chapter is this one, the Penalty History Analysis. The discussions in the previous sections pointed out using numerical data that the State of Indiana does have a problem completing its final construction contract payment procedure within the 180 day limit and indicated where the problem areas lie. This section gives reasons for the late payment problems. It will show how the penalty reasons were analyzed, what the main reasons for interest penalties are, and will present a few suggestions on how to improve the procedure based on the penalty history analysis.

In order to look at the reasons for penalties, the first thing the researchers had to do was to look at all of the contracts in which final payments were made by the State of Indiana between the start of 1972 and August 31, 1977, and to group all of the contracts in which interest penalties occurred together. This was done using the contractual data supplied by the State of Indiana along with a history form devised by the researchers. For each contract in which an interest penalty was paid, the researchers compiled pertinent information about the contract in reference to reasons for the penalty on what the researchers call their History Analysis Form. A sample of this form can be seen in Figure 10. The data on this form

CONTRACT R-08744

- 1) Seymour district (Dearborn county)
- 2) Penalty amount= \$1231.53
- 3) State project engineer
- 4) Contractor- Olinger Construction (Pre-grading)
- 5) Comments: a) Construction Record received in the Central Office 2 months and 28 days after the 180 day date.
 - b) 10-31-75 IC727: Construction Record not received in the district office.
 - c) 11-30-75 IC727: Construction Record not received in the district office.
 - d) 12-31-75 IC727: Construction Record not received in the district office. The retainage was also dropped from 5% to 1%.
 - e) 1-31-76 IC727: 50% checked by the district office.
 - f) 2-29-76 IC727: Need the M-39 from the contractor and the Division of Materials and Tests' certification.
 - g) 3-31-76 IC727: Need the Division of Materials and Tests' certification.
 - h) 4-30-76 IC727: Need the Division of Materials and Tests' certification.

Last Working Day- 8-25-75

Acceptance Date - 8-25-75

180 Day Date - 2-21-76

Payment - 6-8-76

Note: It took the project engineer approximately four months to get the Construction Record to the district office. Division of Materials and Tests' certification also contributed to the penalty. The retainage reduction saved a lot of money.

Figure 10

is for the State of Indiana contract R-08744 in which a penalty occurred and final payment was made to the contractor in 1976.

Data for this form is derived from two Indiana State Highway Commission sources. The first is the monthly computer printout illustrated in Figure 2 which shows information on contracts completed and paid during the year along with those contracts still in progress. This printout supplies the required information for the following sections of the History Analysis Form:

- a) District and county the contract was performed in
- b) Penalty amount
- c) Type of project engineer
- d) Contractor and type of contract
- e) Last working day date
- f) Acceptance date
- g) 180 day date
- h) Final payment date

The second information source is the IC 727 form which the Indiana State Highway Commission entitles the Road and Bridge Construction Record Status Report. It should be pointed out here that this report also covers the other three types of highway related construction contracts. The IC 727 is issued monthly and it lists the status of each contract that has been completed and accepted but has not had its final payment sent to the contractor. This form shows what part of the final construction contract payment procedure the contract is in, along with reasons why the process is still in progress. The IC 727 form is used to complete the Comments Section of the

History Analysis Form along with the Note Section at the bottom.

The Note Section on the History Analysis Form is used as a summary. The analyst looks at the reasons for penalties in the Comments Section and states the primary reason or reasons for the penalty in the Notes Section. This saves time when a later numerical analysis just looks at the primary penalty reason.

As can be seen from Figure 10, the R-08744 contract had a substantial penalty-- \$1231.53. The two primary reasons for the penalty were that the project engineer turned the Construction Record into the District Office late, along with the late issuance of the Division of Materials and Tests certification. Also, it should be mentioned that a lot of money in interest penalties was saved by the State of Indiana on this contract when it dropped the contractor's retainage from 5% to 1%.

Every contract in which a penalty occurred since 1972 had a History Analysis Form filled out for it by the researchers. In doing this, it was noticed that there is a lack of uniformity on several of the items which make up the IC 727. These irregularities will be discussed separately in the following three paragraphs.

The first lack of uniformity is that of when the contract is first placed on the IC 727. In doing the history on each of the contracts with penalties, the researchers noticed that several of the contracts are not showing up on the IC 727 until a month or two before the 180 day payment period runs out. It seems as though it should be a mandatory requirement to put the contract on the IC 727 the month it is finally accepted. This would allow all

concerned to look at the IC 727 and know which accepted contracts have not been received in the District Office within one or two months after the start of the 180 day payment period. The responsible project engineer could then be notified of his lateness and fewer interest penalties should result.

The second lack of uniformity on the IC 727 deals with the Construction Record receipt in the District Office. A few of the districts show for each contract on the IC 727 the date the Construction Record was received in the District Office. This is a very good practice and should be a standard one throughout all six State of Indiana highway districts. By doing this routinely, it would be easy to determine which project engineers are submitting their Construction Records late. If it turns out to be a chronic problem for certain project engineers, then maybe it would be time to change personnel.

The third lack of uniformity pertains to penalty reasons. On several of the IC 727's, even though the contract is listed and the payment procedure is in progress, no note on its status was given. A monthly contract status update should be a requirement for all contracts. This would allow all personnel involved with the final construction contract payment procedure to discover the problems sooner and to take the necessary corrective actions to lower the amount of interest penalty paid to the contractor.

In completing the History Analysis Form for all of the contracts with penalties, several reasons for the contract penalties surfaced. The most prevalent reasons were listed in the Computer Program

Development section (7.1). This list of reasons contains four which illustrate delays due to the contractor. They are as follows:

- a) Need the M-39 from the contractor
- b) Need an approved IC 626 from the Central Office or the contractor
- c) Late issuance of the supplemental IT 611's
- d) Contractor protesting work day charges or approval of extension time

No penalty is paid by the State of Indiana due to this time charged to the contractor.

After completing the History Analysis Forms for all of the contracts with penalties from 1972 through August 31, 1977, the researchers were able to determine which reasons for contract penalties are the most prevalent. Two assumptions were necessary to complete this analysis; they are as follows:

- 1) If the project engineer took greater than two months after the contract acceptance date to get the Construction Record to the District Office, he contributed to the interest penalty.
- 2) If a reason shows up in the Comments Section of the History Analysis Form for two or more consecutive months, it contributed to the penalty.

With these two assumptions in mind, it should be realized that for each penalty contract, there can be more than one reason for the penalty. As will be seen on the penalty reason analysis data tables, the penalty reason percentages will add up to greater than 100%.

This is due to some contracts having more than one penalty reason.

Tables 24, 25, and 26 are the penalty reason analysis tabulations for 1975, 1976, and 1977. Only those reasons showing up equal to or greater than 10% of the time are placed on the tables. Also, data for 1972, 1973, and 1974 is not analyzed due to so few contracts with penalties during those years. All three tables show that the two primary reasons for interest penalties are project engineer lateness and late issuance of the Division of Materials and Tests certification. However, it should be stated that the tabulated percentages for these two reasons might actually be a little high. This is because both reasons sometimes involve extenuating circumstances. First, the project engineer is sometimes immediately sent to another job without time to adequately complete the Construction Record on the project he just completed. He then has to try to complete it while at the same time begin his new job. Secondly, sometimes when the Division of Materials and Tests is listed as not issuing its certification, it is waiting on an answer to a discrepancy letter or a material certification from the district. Therefore, these two excuses help to lower the penalty percentages somewhat but the fact still remains that project engineer lateness and the Division of Materials and Tests are the two main reasons for contract penalties up to now.

7.8 Liquidated Damages Analysis

This final section of the Data Analysis chapter is different from those previously explained. The others showed where the State of Indiana's problems were in the final construction contract payment

Table 24

1975 PENALTY REASON ANALYSIS

<u>REASON FOR THE PENALTY</u>	<u>PERCENTAGE OF OCCURRENCES</u>
Project engineer turned in the Construction Record late	69%
Late issuance of the Division of Materials and Tests' certification	46%
Need the M-39 from the contractor	10%
Need an approved IC 626 from the Central office or the contractor	10%

Table 25

1976 PENALTY REASON ANALYSIS

<u>REASON FOR THE PENALTY</u>	<u>PERCENTAGE OF OCCURRENCES</u>
Project engineer turned in the Construction Record late	57%
Late issuance of the Division of Materials and Tests' certification	44%
Need the M-39 from the contractor	16%

Table 26

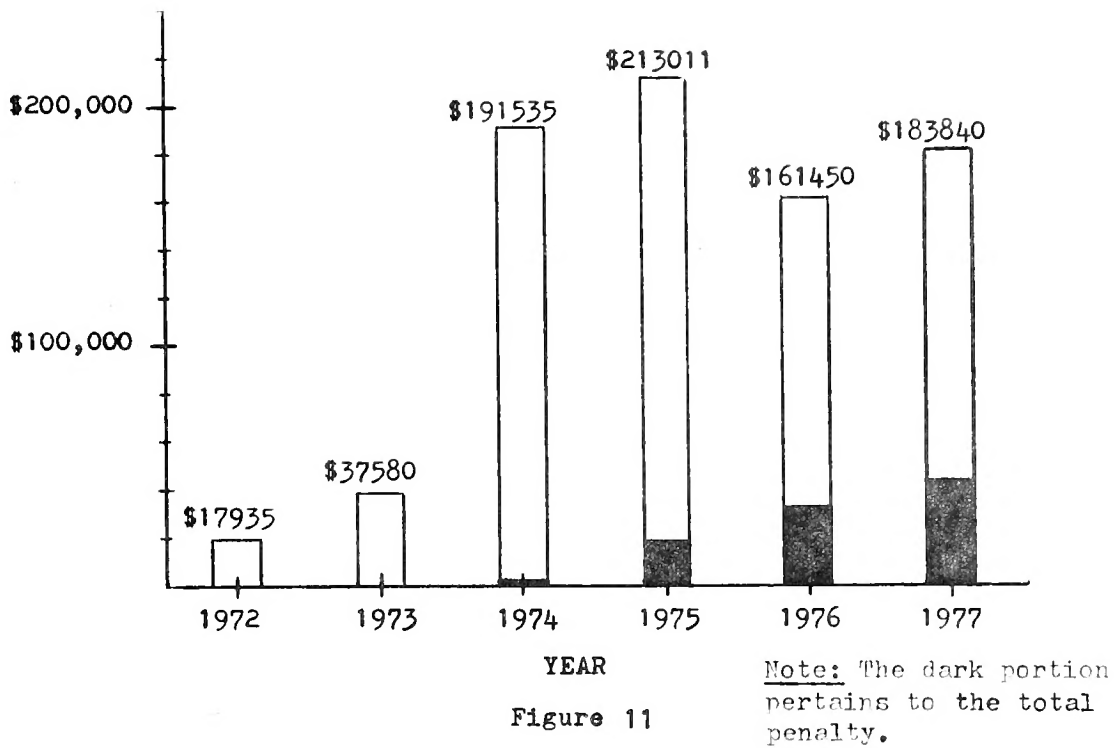
1977 PENALTY REASON ANALYSIS

<u>REASON FOR THE PENALTY</u>	<u>PERCENTAGE OF OCCURRENCES</u>
Late issuance of the Division of Materials and Tests' certification	60%
Project engineer turned in the Construction Record late	54%
Late issuance of the District Office Materials' Certification	34%
Need M-39 from the contractor	16%
Project engineer turned in the Construction Record incomplete or with revisions required	14%
Late issuance of supplemental IT 611's	12%
Lengthy check in the district office	10%

procedure in terms of contract type, contract duration, geographic district, or project engineer type. Liquidated damages are problems to the contractor, not the State of Indiana. A liquidated damage is that charge the contractor has to pay to the State of Indiana for completing the contract late. It is usually based on a charge per day late basis and this charge is multiplied by the number of days late to get the total amount of liquidated damages due the State of Indiana.

The researchers felt that it might be interesting to compare the liquidated damages received from the contractor to the interest penalties paid out to him for each year. This data can be seen in Figure 11. Below the figure is Table 27 which shows the total amount of liquidated damages for each year, the total number of contracts making up this total, and the average liquidated damage total for each year. The dark portion on Figure 11 pertains to total penalties.

As can be easily seen on Figure 11, the amount of liquidated damages paid by the contractor each year to the State of Indiana greatly exceeds the interest penalties expended. One could say therefore that interest penalties are not a serious problem to consider since the liquidated damages more than cancel them out. This opinion is wrong; the State of Indiana cannot depend on the contractor being late in his contract completion in order to pay for its interest penalties. Liquidated damages are good in that they provide extra revenue for the State of Indiana; however, they are bad in that the project is delayed and it might be more beneficial to the State of Indiana to have the project done sooner rather than becoming richer while the project sits unfinished.



LIQUIDATED DAMAGES VERSUS TOTAL PENALTY BAR CHART

Table 27

LIQUIDATED DAMAGES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL</u>	<u>NUMBER</u>	<u>AVERAGE</u>
1972	\$17935	13	\$1379.62
1973	\$37580	23	\$1633.91
1974	\$191535	36	\$5320.42
1975	\$213011	50	\$4260.22
1976	\$161450	36	\$4484.72
1977	\$183840	44	\$4178.18

The 1977 liquidated damages data are projections founded upon the following eight month data:

- a) Total liquidated damages in 1977 - 1122560
- b) Number of contracts making up the
liquidated damages in 1977 - 29

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

The following three sections list the researchers' conclusions and recommendations pertaining to the final construction contract payment procedure and the Construction Record Guide.

8.1 Conclusions

The primary objective of this research paper was to provide an analysis of the final construction contract payment procedure of the Indiana State Highway Commission in order to give reasons, backed up by contract data, why the State of Indiana is having trouble paying its highway construction contracts on time. To carry out this analysis, the researcher had to investigate all of the components which make up the procedure. These are as follows: computation of final work item quantities using the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts, completion of the Construction Record by the project engineer with these final work item quantities, checking of the Construction Record by the District Review Officer, and issuance of the materials' certifications. Another major aspect of the analysis was the compilation of highway construction contract data from 1972 through August 31, 1977. The data gathering provided proof that the State of Indiana does have difficulty paying its contracts on time and indicates how bad the problem actually is.

The major conclusion of the research is that the problem of late payment deals mainly with two groups of men who work for the State of Indiana. The first of these are the project engineers. Contract data shows that through the habits of some to put off the necessary paperwork related to the final construction contract payment procedure, the final payments due the contractor are paid late which results in a substantial yearly interest penalty. The second group to contribute to the difficulty of paying contracts on time is the personnel at the Division of Materials and Tests. Their cyclical organizational structure of paperwork flow has added many dollars to the interest penalty amount. However, they have in the past few months changed this organizational structure to a more hierarchical one, but it is too early for the data to show that the interest penalties will be decreasing because of this needed alteration.

This research paper's recommendations of how the final construction contract payment procedure can be improved along with those on improving the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts can be found in the following two sections. They summarize both the opinions of the researchers along with the many District Review Officers and project engineers who were interviewed throughout the State of Indiana.

From the Data Analysis chapter, one can see that in terms of penalty dollars, the late payment problem has gotten worse every year. However, in terms of the percentage of contracts in which penalties were paid, there was an improvement as shown on the projected data for 1977.

Finally, it should be stated that the researchers feel that this area of interest penalties is a very important aspect of contractual interactions between the contractors and the State of Indiana. It has been said that the \$44,000 to be paid out in interest penalties this year is negligible when compared to the several millions the contracts were worth. However, a more important issue than money is at stake here. One's goal in construction is to provide the best project at the lowest possible cost. The Construction Record is the primary responsibility of the project engineer. A project engineer who neglects his paperwork and causes a penalty to be paid to the contractor is not only increasing the project's final cost, he is also costing the State in terms of time where he could be starting another job rather than finishing up his late paperwork. To strive to do one's best at something is admittedly much harder than to accept something less. However, to carry out inferior project management techniques, as do many of the project engineers, leads to a poor quality project at a high cost. Therefore, additional monitoring in this interest penalty area should be carried out in the future. The interest penalty total along with the appropriate reasons for penalties provide an excellent barometer of the quality of work being carried out in the State of Indiana and of the quality of its personnel.

8.2 Recommendation Summary Pertaining to the Final Construction

Contract Payment Procedure

The following is a compilation of the researchers' recommendations in reference to the final construction contract payment procedure of the Indiana State Highway Commission; all are elaborated upon in the text of this research paper. It is felt that using any or all of the recommendations will result in increased efficiency in the final construction contract payment procedure.

- 1) Institute a standard policy of District Review Officers issuing preliminary quantity IC 642's to the material certification laboratories only for problem work items (e.g. those with disputed quantities or those taking a long time to calculate).
- 2) Stop the practice of issuing Contractor's Inspection of the Final Construction Record Report (M-39) forms to the contractor prior to receipt of both material certifications.
- 3) Require all project engineers including city and county to attend periodic workshops on the preparation of Construction Records taught by District Review Officers.
- 4) Allow only the District Review Officer and a field-experienced assistant to check the Construction Records.
- 5) Set up an annual meeting between the six District Review Officers so they can discuss their problems and prevent procedural divergence.
- 6) Notify project engineers that the Recommended

Change in Plans, Materials, or Quantities (IC 626) forms can be completed by them with estimated quantities.

- 7) Allow District Review Officers to initiate retainage reductions.
- 8) Assign all project engineers an office assistant to help in the preparation of the Construction Record.
- 9) Encourage the Construction Record to be checked in sections throughout the job.
- 10) Work up a job description for the District Review Officers.
- 11) Require the project engineer to prepare his own Material Record (IT 611) forms each month in order to check the contractor.
- 12) Require all District Review Officers to be field-experienced and graduate civil engineers.
- 13) Stop the two distribution cycles at the Division of Materials and Tests by giving the Assistant to the Office Engineer a subordinate and let them do all of the material certification checking.
- 14) Require only a Division of Materials and Tests certification instead of also requiring the District Office Materials' Laboratory certification.
- 15) Require that all manufacturer's certifications be checked by the Division of Materials and Tests.
- 16) Computerize the checking procedure at the Division of Materials and Tests.
- 17) Require a contract completed during a month to be listed

- on the next month's IC 727 form.
- 18) Require that the date the Construction Record arrives in the District Office is listed beside the contract on the IC 727 form.
 - 19) Require that the status of each completed contract be listed for every month a contract is on the IC 727 form.

8.3 Recommendation Summary Pertaining to the Construction Record Guide

Throughout the text of this research paper are recommendations which propose to improve the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. They were derived in order to aid the project engineer's preparation of the Construction Record along with facilitating the checking of it by the District Review Officer. The recommendations are compiled in this section to provide for easier reference. Therefore, the following recommendations developed from the research study pertain to the Construction Record Guide:

- 1) Make the corrections to the Construction Record Guide shown on the errata sheets in Appendix C.
- 2) Require the project engineers to reference their field book sketches more frequently rather than recopying them onto IC 614 forms.
- 3) Add a new section for Bridge Deck Repair Items.
- 4) Require all calculations to be carried out in work item quantities. This would remove the need for three forms of calculation accuracies.

- 5) In reference to contracts with federal funding, include a new section or incorporate Supplemental Instructions to Field Employees-No. 18 into the Construction Record Guide to show the project engineers how to handle this type of contract.
- 6) Do not require the usage of the IC 612B Pipe and Concrete Structures form if the same information it summarizes can be easily referenced in the project engineer's field book.
- 7) Computerize the dirt quantity calculations statewide. However, provide the District Review Officers with as-built cross section drawings so they can check the computer printout.
- 8) Do not require the usage of the IC 611A Pavement form if the same information it summarizes can be easily referenced in the project engineer's field book.
- 9) Place the new IC 654 Record of Construction (Concrete) form in the Construction Record Guide along with instructions of how it should be filled out.
- 10) Provide a work item example for Unclassified Excavation.
- 11) Provide a section in the Construction Record Guide showing the Central Office's opinion of the order of work items and forms to be included in the Construction Record.

LIST OF REFERENCES

LIST OF REFERENCES

- Indiana State Highway Commission. 1970 Construction Record Guide for Road, Bridge, Maintenance and Traffic Contracts.
- Indiana State Highway Commission. General Instructions to Field Employees-Division of Construction, 1970.
- Indiana State Highway Commission, Division of Materials and Tests. Manual for Frequency of Sampling & Testing and Basis for Use of Materials, April 1974.
- Indiana State Highway Commission. Standard Specifications, 1974.

APPENDICES

Appendix A

Appendix A

COMPILED PROGRAM

06/05/76 UNIVERSITY OF MINNESOTA FORTRAN PURDUE VERSION MOD NO. 3 PSK4.3 10/27/77, 12.03.78.
MNF.

```

C * * * * *
C   THIS PROGRAM WAS WRITTEN BY DAVID L. HAYS FOR HIS MASTER'S
C   THESIS ENTITLED AN INVESTIGATION OF THE FINAL CONSTRUCTION
C   CONTRACT PAYMENT PROCEDURE FOR THE INDIANA STATE HIGHWAY
C   COMMISSION.* THE PROGRAM PROVIDES FOR A STATISTICAL ANALYSIS
C   OF ALL HIGHWAY CONTRACTS FROM JANUARY 1972 TO THE PRESENT.
C * * * * *
C   THE EXPRESSION PERTAINING TO CONTRACT NAMES WILL BE C.
C * * * * *
C   THE FOLLOWING ARE THE 5 TYPES OF INDIANA HIGHWAY CONTRACTS**
C       1 R**ROAD
C       2 B**BRIDGE
C       3RT**ROAD*TRAFFIC
C       4RS**ROAD*SURFACING
C       5RH**ROAD*MAINTENANCE
C   THE EXPRESSION PERTAINING TO THE CONTRACT TYPES WILL BE IT.
C * * * * *
C   THE FOLLOWING ARE THE 3 TYPES OF INDIANA HIGHWAY CONTRACTS
C   PERTAINING TO WHOSE ENGINEER IS IN CHARGE OF THE JOB**
C       1**CITY
C       2**COUNTY
C       3**STATE
C   THE EXPRESSION PERTAINING TO THESE THREE TYPES WILL BE ICE.
C * * * * *
C   THE EXPRESSION PERTAINING TO PENALTIES (INTEREST) WILL BE IP.
C   THE DESIGNATION WILL BE AS FOLLOWS**
C       1**PENALTY WAS PAID
C       2**PENALTY WAS NOT REQUIRED
C * * * * *
C   THE EXPRESSION PERTAINING TO THE PENALTY AMOUNT WILL BE PA.
C * * * * *
C   THE FOLLOWING ARE THE 6 HIGHWAY DISTRICTS FOR INDIANA**
C       1**CHAMFORDSVILLE
C       2**FORD WAYNE
C       3**GREENFIELD
C       4**LA PORTE
C       5**SEYMOUR
C       6**VINCENNES
C   THE EXPRESSION PERTAINING TO THE DISTRICTS WILL BE ID.
C * * * * *
C   THE FOLLOWING ARE POSSIBLE REASONS FOR PENALTIES**
C       0**NO PENALTY
C       1**PROJECT ENGINEER TURNED IN THE DOCUMENTS LATE
C       2**LATE ISSUANCE OF THE CENTRAL OFFICE MATERIAL
C           CERTIFICATION
C       3**PROJECT ENGINEER TURNED IN THE DOCUMENTS
C           INCOMPLETE OR WITH REVISIONS REQUIRED
C       4**NEEDED THE M*39 FROM THE CONTRACTOR
C       5**NEED AN APPROVED IC 62b FROM THE CENTRAL OFFICE
C           OR THE CONTRACTOR
C       6**LENGTHY CHECK IN THE DISTRICT OFFICE
C       7**LATE ISSUANCE OF THE DISTRICT OFFICE MATERIAL
C           CERTIFICATION
C       8**LATE ISSUANCE OF THE SUPPLEMENTAL IT 6114S
C       9**LATE RECEIVAL OF A SIGN CERTIFICATION LETTER
C       10**LENGTHY PROCESSING BY IBM

```


C 11***DELAY AT THE CENTRAL OFFICE (INDIANAPOLIS)
 C 12***LATE ISSUANCE OF A CORE REPORT
 C 13***CONTRACTOR PROTESTING WORK DAY CHARGES OR
 C APPROVAL OF EXTENSION TIME
 C 14***HOLDING FOR LAB NUMBERS
 C 15***AWAITING FHWA APPROVAL FOR A TIME EXTENSION
 C 16***AWAITING IC 115 (EXTRA WORK AGREEMENT)
 C THE EXPRESSION PERTAINING TO THE REASONS FOR PENALTIES WILL BE IN.
 C *
 C THE FOLLOWING ARE THE DESIGNATIONS FOR THE YEAR EACH CONTRACT
 C HAD THE FINAL ESTIMATE PAID.
 C 2***1972
 C 3***1973
 C 4***1974
 C 5***1975
 C 6***1976
 C 7***1977
 C THE EXPRESSION PERTAINING TO THESE YEARS WILL BE IN.
 C *
 C THIS PROGRAM IS DESIGNED AT PRESENT TO BE SEPARATELY RUN FOR
 C EACH YEAR FROM 1972 THRU 1977
 C *
 C N=TOTAL NUMBER OF CONTRACTS FOR THE YEAR
 C N1=NUMBER OF ROAD CONTRACTS FOR THE YEAR
 C N2=NUMBER OF ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
 C N11=NUMBER OF ROAD CONTRACTS WITH A CITY PROJECT ENGINEER
 C N12=NUMBER OF CITY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
 C N13=NUMBER OF ROAD CONTRACTS WITH A COUNTY PROJECT ENGINEER
 C N14=NUMBER OF COUNTY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
 C N15=NUMBER OF ROAD CONTRACTS WITH A STATE PROJECT ENGINEER
 C N16=NUMBER OF STATE ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
 C N17=NUMBER OF ROAD CONTRACTS IN DISTRICT 1
 C N18=NUMBER OF ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
 C N19=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 1
 C N20=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
 C N21=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 1
 C N22=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
 C N23=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 1
 C N24=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
 C N25=NUMBER OF ROAD CONTRACTS IN DISTRICT 2
 C N26=NUMBER OF ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
 C N27=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 2
 C N28=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
 C N29=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 2
 C N30=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
 C N31=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 2
 C N32=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
 C N33=NUMBER OF ROAD CONTRACTS IN DISTRICT 3
 C N34=NUMBER OF ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
 C N35=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 3
 C N36=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
 C N37=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 3
 C N38=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
 C N39=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 3
 C N40=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
 C N41=NUMBER OF ROAD CONTRACTS IN DISTRICT 4
 C N42=NUMBER OF ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
 C N43=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 4


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C      N44=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
C      N45=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 4
C      N46=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
C      N47=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 4
C      N48=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
C      N49=NUMBER OF ROAD CONTRACTS IN DISTRICT 5
C      N50=NUMBER OF ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
C      N51=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 5
C      N52=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
C      N53=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 5
C      N54=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
C      N55=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 5
C      N56=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
C      N57=NUMBER OF ROAD CONTRACTS IN DISTRICT 6
C      N58=NUMBER OF ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
C      N59=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 6
C      N60=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
C      N61=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 6
C      N62=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
C      N63=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 6
C      N64=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
C* . . . . .
C      X=TOTAL PENALTY FOR ROAD CONTRACTS
C      X1=TOTAL PENALTY FOR CITY ROAD CONTRACTS
C      X2=TOTAL PENALTY FOR COUNTY ROAD CONTRACTS
C      X3=TOTAL PENALTY FOR STATE ROAD CONTRACTS
C      X4=TOTAL PENALTY FOR DISTRICT 1 ROAD CONTRACTS
C      X5=TOTAL PENALTY FOR DISTRICT 1 CITY ROAD CONTRACTS
C      X6=TOTAL PENALTY FOR DISTRICT 1 COUNTY ROAD CONTRACTS
C      X7=TOTAL PENALTY FOR DISTRICT 1 STATE ROAD CONTRACTS
C      X8=TOTAL PENALTY FOR DISTRICT 2 ROAD CONTRACTS
C      X9=TOTAL PENALTY FOR DISTRICT 2 CITY ROAD CONTRACTS
C      X10=TOTAL PENALTY FOR DISTRICT 2 COUNTY ROAD CONTRACTS
C      X11=TOTAL PENALTY FOR DISTRICT 2 STATE ROAD CONTRACTS
C      X12=TOTAL PENALTY FOR DISTRICT 3 ROAD CONTRACTS
C      X13=TOTAL PENALTY FOR DISTRICT 3 CITY ROAD CONTRACTS
C      X14=TOTAL PENALTY FOR DISTRICT 3 COUNTY ROAD CONTRACTS
C      X15=TOTAL PENALTY FOR DISTRICT 3 STATE ROAD CONTRACTS
C      X16=TOTAL PENALTY FOR DISTRICT 4 ROAD CONTRACTS
C      X17=TOTAL PENALTY FOR DISTRICT 4 CITY ROAD CONTRACTS
C      X18=TOTAL PENALTY FOR DISTRICT 4 COUNTY ROAD CONTRACTS
C      X19=TOTAL PENALTY FOR DISTRICT 4 STATE ROAD CONTRACTS
C      X20=TOTAL PENALTY FOR DISTRICT 5 ROAD CONTRACTS
C      X21=TOTAL PENALTY FOR DISTRICT 5 CITY ROAD CONTRACTS
C      X22=TOTAL PENALTY FOR DISTRICT 5 COUNTY ROAD CONTRACTS
C      X23=TOTAL PENALTY FOR DISTRICT 5 STATE ROAD CONTRACTS
C      X24=TOTAL PENALTY FOR DISTRICT 6 ROAD CONTRACTS
C      X25=TOTAL PENALTY FOR DISTRICT 6 CITY ROAD CONTRACTS
C      X26=TOTAL PENALTY FOR DISTRICT 6 COUNTY ROAD CONTRACTS
C      X27=TOTAL PENALTY FOR DISTRICT 6 STATE ROAD CONTRACTS
C* . . . . .
C      NOTE** THE DEFINITIONS ABOVE FOR THE N AND X VARIABLES ARE FOR
C              ROAD CONTRACTS. FOR THE OTHER CONTRACTS, THE SAME
C              DEFINITIONS APPLY EXCEPT THAT FOR BRIDGES, M AND Y ARE
C              USED, FOR ROAD*TRAFFIC, L AND Z ARE USED, FOR
C              ROAD*SURFACING, K AND V ARE USED, AND FOR ROAD*MAINTENANCE
C              J AND U ARE USED.
C* . . . . .

```



```

000000= 1. DATA N,N1,N2,N11,N12,N13,N14,N15,N16/9*0/
002051= 2. DATA N17,N18,N19,N20,N21,N22,N23,N24,N25,N26,N27,N28,N29/13*0/
002051= 3. DATA N30,N31,N32,N33,N34,N35,N36,N37,N38,N39,N40,N41,N42/13*0/
002051= 4. DATA N43,N44,N45,N46,N47,N48,N49,N50,N51,N52,N53,N54,N55/13*0/
002051= 5. DATA N56,N57,N58,N59,N60,N61,N62,N63,N64/9*0/
002051= 6. DATA X,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,X11,X12,X13,X14,X15/16*0.00/
002051= 7. DATA X16,X17,X18,X19,X20,X21,X22,X23,X24,X25,X26,X27/12*0.00/
002051= 8. DATA M1,M2,M11,M12,M13,M14,M15,M16/8*0/
002051= 9. DATA M17,M18,M19,M20,M21,M22,M23,M24,M25,M26,M27,M28,M29/13*0/
002051= 10. DATA M30,M31,M32,M33,M34,M35,M36,M37,M38,M39,M40,M41,M42/13*0/
002051= 11. DATA M43,M44,M45,M46,M47,M48,M49,M50,M51,M52,M53,M54,M55/13*0/
002051= 12. DATA Y56,M57,M58,M59,M60,M61,M62,M63,M64/9*0/
002051= 13. DATA Y,Y1,Y2,Y3,Y4,Y5,Y6,Y7,Y8,Y9,Y10,Y11,Y12,Y13,Y14,Y15/16*0.00/
002051= 14. DATA Y16,Y17,Y18,Y19,Y20,Y21,Y22,Y23,Y24,Y25,Y26,Y27/12*0.00/
002051= 15. DATA L1,L2,L11,L12,L13,L14,L15,L16/8*0/
002051= 16. DATA L17,L18,L19,L20,L21,L22,L23,L24,L25,L26,L27,L28,L29/13*0/
002051= 17. DATA L30,L31,L32,L33,L34,L35,L36,L37,L38,L39,L40,L41,L42/13*0/
002051= 18. DATA L43,L44,L45,L46,L47,L48,L49,L50,L51,L52,L53,L54,L55/13*0/
002051= 19. DATA L56,L57,L58,L59,L60,L61,L62,L63,L64/9*0/
002051= 20. DATA Z,Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,Z10,Z11,Z12,Z13,Z14,Z15/16*0.00/
002051= 21. DATA Z16,Z17,Z18,Z19,Z20,Z21,Z22,Z23,Z24,Z25,Z26,Z27/12*0.00/
002051= 22. DATA K1,K2,K11,K12,K13,K14,K15,K16/8*0/
002051= 23. DATA K17,K18,K19,K20,K21,K22,K23,K24,K25,K26,K27,K28,K29/13*0/
002051= 24. DATA K30,K31,K32,K33,K34,K35,K36,K37,K38,K39,K40,K41,K42/13*0/
002051= 25. DATA K43,K44,K45,K46,K47,K48,K49,K50,K51,K52,K53,K54,K55/13*0/
002051= 26. DATA K56,K57,K58,K59,K60,K61,K62,K63,K64/9*0/
002051= 27. DATA V,V1,V2,V3,V4,V5,V6,V7,V8,V9,V10,V11,V12,V13,V14,V15/16*0.00/
002051= 28. DATA V16,V17,V18,V19,V20,V21,V22,V23,V24,V25,V26,V27/12*0.00/
002051= 29. DATA J1,J2,J11,J12,J13,J14,J15,J16/8*0/
002051= 30. DATA J17,J18,J19,J20,J21,J22,J23,J24,J25,J26,J27,J28,J29/13*0/
002051= 31. DATA J30,J31,J32,J33,J34,J35,J36,J37,J38,J39,J40,J41,J42/13*0/
002051= 32. DATA J43,J44,J45,J46,J47,J48,J49,J50,J51,J52,J53,J54,J55/13*0/
002051= 33. DATA J56,J57,J58,J59,J60,J61,J62,J63,J64/9*0/
002051= 34. DATA U,U1,U2,U3,U4,U5,U6,U7,U8,U9,U10,U11,J12,J13,U14,U15/16*0.00/
002051= 35. DATA U16,U17,U18,U19,U20,U21,U22,U23,U24,U25,U26,U27/12*0.00/
002051= 36. PRINT 703
002722= 37. 703 FORMAT (#1#,20X,#CONTRACTS WITH PENALTIES#,8X,#PENALTY AMOUNT#)
002722= 38. 100 READ 101,C,IT,ICE,IP,PA,IO,IR,TY
002736= 39. 101 FORMAT (A8,X,I2,X,I1,X,I1,X,F8.2,X,I1,X,I2,X,I1)
002736= 40. IF (IT.EQ.0) GO TO 999
002737= 41. IF (IP.EQ.1) GO TO 700
002740= 42. 702 N=N+1
002742= 43. GO TO 704
002742= 44. 700 PRINT 701,C,PA
002751= 45. 701 FORMAT (/ ,25X,A8,22X,F8.2)
002751= 46. GO TO 702
002751= 47. 704 IF (IT.EQ.1) GO TO 102
002753= 48. IF (IT.EQ.2) GO TO 104
002755= 49. IF (IT.EQ.3) GO TO 106
002756= 50. IF (IT.EQ.4) GO TO 108
002766= 51. IF (IT.EQ.5) GO TO 107
002761= 52. GO TO 100
C * * * * *
C * THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE ROAD CONTRACTS
C * * * * *
002762= 53. 102 M1=N1+1
002764= 54. IF (IP.EQ.1) GO TO 103
002766= 55. GO TO 112

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002765J 56. 103 N2=N2+1
002770J 57. X=X+PA
C* * * * *
C THIS SECTION ANALYZES THE ROAD CONTRACTS BY CITY, COUNTY, OR
C STATE PROJECT ENGINEER.
C* * * * *

002771L 58. 112 IF (ICE.EQ.1) GO TO 113
002773L 59. IF (ICE.EQ.2) GO TO 114
002775J 60. IF (ICE.EQ.3) GO TO 115
002776L 61. GO TO 117
002777L 62. 113 N11=N11+1
003001G 63. IF (IP.EQ.1) GO TO 116
003003R 64. GO TO 117
003003B 65. 116 N12=N12+1
003005B 66. X1=X1+PA
003006B 67. GO TO 117
003007B 68. 114 N13=N13+1
003011L 69. IF (IP.EQ.1) GO TO 118
003013L 70. GO TO 117
003013L 71. 118 N14=N14+1
003015J 72. X2=X2+PA
003016L 73. GO TO 117
003017L 74. 115 N15=N15+1
003021J 75. IF (IP.EQ.1) GO TO 119
003023L 76. GO TO 117
003023J 77. 119 N16=N16+1
003025B 78. X3=X3+PA
C* * * * *
C THIS SECTION ANALYZES ROAD CONTRACTS BY DISTRICTS.
C* * * * *

003026L 79. 117 IF (ID.EQ.1) GO TO 120
003030J 80. IF (ID.EQ.2) GO TO 121
003032L 81. IF (ID.EQ.3) GO TO 122
003033B 82. IF (ID.EQ.4) GO TO 123
003035J 83. IF (ID.EQ.5) GO TO 124
003036L 84. IF (ID.EQ.6) GO TO 125
003040L 85. GO TO 126
C* * * * *
C DISTRICT 1 ANALYSIS
C* * * * *

003041L 86. 120 N17=N17+1
003042L 87. IF (IP.EQ.1) GO TO 127
003044B 88. GO TO 128
003044L 89. 127 N18=N18+1
003046L 90. X4=X4+PA
003047B 91. 128 IF (ICE.EQ.1) GO TO 129
003051B 92. IF (ICE.EQ.2) GO TO 130
003053B 93. IF (ICE.EQ.3) GO TO 131
003054L 94. GO TO 126
003055L 95. 129 N19=N19+1
003057L 96. IF (IP.EQ.1) GO TO 132
003061B 97. GO TO 126
003061J 98. 132 N20=N20+1
003063L 99. X5=X5+PA
003064B 100. GO TO 126
003065B 101. 130 N21=N21+1
003067L 102. IF (IP.EQ.1) GO TO 133
003071J 103. GO TO 126

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003071b 104. 133 N22=N22+1
003073b 105. X6=X6+PA
003074b 106. GO TO 12b
003075b 107. 131 N23=N23+1
003077b 108. IF (IP.EQ.1) GO TO 134
003101b 109. GO TO 12b
003101b 110. 134 N24=N24+1
003103b 111. X7=X7+PA
003104b 112. GO TO 12b
C* * * * *
C
C* * * * *
DISTRICT 2 ANALYSIS
C* * * * *
003105b 113. 121 N25=N25+1
003107b 114. IF (IP.EQ.1) GO TO 135
003111b 115. GO TO 13b
003111b 116. 135 N26=N26+1
003113b 117. X8=X8+PA
003114b 118. 136 IF (ICE.EQ.1) GO TO 137
003115b 119. IF (ICE.EQ.2) GO TO 138
003120b 120. IF (ICE.EQ.3) GO TO 139
003121b 121. GO TO 12b
003122b 122. 137 N27=N27+1
003124b 123. IF (IP.EQ.1) GO TO 140
003126b 124. GO TO 12b
003126b 125. 140 N28=N28+1
003133b 126. X9=X9+PA
003131b 127. GO TO 12b
003132b 128. 138 N29=N29+1
003134b 129. IF (IP.EQ.1) GO TO 141
003136b 130. GO TO 12b
003136b 131. 141 N30=N30+1
003140b 132. X10=X10+PA
003141b 133. GO TO 12b
003142b 134. 139 N31=N31+1
003144b 135. IF (IP.EQ.1) GO TO 142
003146b 136. GO TO 12b
003146b 137. 142 N32=N32+1
003150b 138. X11=X11+PA
003151b 139. GO TO 12b
C* * * * *
C
C* * * * *
DISTRICT 3 ANALYSIS
C* * * * *
003152b 140. 122 N33=N33+1
003154b 141. IF (IP.EQ.1) GO TO 143
003156b 142. GO TO 144
003156b 143. 143 N34=N34+1
003160b 144. X12=X12+PA
003161b 145. 144 IF (ICE.EQ.1) GO TO 145
003163b 146. IF (ICE.EQ.2) GO TO 146
003165b 147. IF (ICE.EQ.3) GO TO 147
003166b 148. GO TO 12b
003167b 149. 145 N35=N35+1
003171b 150. IF (IP.EQ.1) GO TO 148
003173b 151. GO TO 12b
003173b 152. 148 N36=N36+1
003175b 153. X13=X13+PA
003176b 154. GO TO 12b
003177b 155. 146 N37=N37+1

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0032013 156. IF (IP.EQ.1) GO TO 149
0032036 157. GO TO 126
0032036 158. 149 N38=N38+1
0032096 159. X14=X14+PA
0032066 160. GO TO 126
0032073 161. 147 N39=N39+1
0032116 162. IF (IP.EQ.1) GO TO 150
0032135 163. GO TO 126
0032136 164. 150 N40=N40+1
0032158 165. X15=X15+PA
0032166 166. GO TO 126
C* * * * *
C DISTRICT 4 ANALYSIS
C* * * * *
0032178 167. 123 N41=N41+1
0032215 168. IF (IP.EQ.1) GO TO 151
0032236 169. GO TO 152
0032236 170. 151 N42=N42+1
0032256 171. X16=X16+PA
0032266 172. 152 IF (ICE.EQ.1) GO TO 153
0032306 173. IF (ICE.EQ.2) GO TO 154
0032326 174. IF (ICE.EQ.3) GO TO 155
0032336 175. GO TO 126
0032346 176. 153 N43=N43+1
0032368 177. IF (IP.EQ.1) GO TO 156
0032403 178. GO TO 126
0032408 179. 156 N44=N44+1
0032426 180. X17=X17+PA
0032433 181. GO TO 126
0032446 182. 154 N45=N45+1
0032466 183. IF (IP.EQ.1) GO TO 157
0032506 184. GO TO 126
0032506 185. 157 N46=N46+1
0032526 186. X18=X18+PA
0032533 187. GO TO 126
0032546 188. 155 N47=N47+1
0032563 189. IF (IP.EQ.1) GO TO 158
0032606 190. GO TO 126
0032603 191. 158 N48=N48+1
0032626 192. X19=X19+PA
0032636 193. GO TO 126
C* * * * *
C DISTRICT 5 ANALYSIS
C* * * * *
0032646 194. 124 N49=N49+1
0032666 195. IF (IP.EQ.1) GO TO 159
0032706 196. GO TO 160
0032706 197. 159 N50=N50+1
0032726 198. X20=X20+PA
0032736 199. 160 IF (ICE.EQ.1) GO TO 161
0032756 200. IF (ICE.EQ.2) GO TO 162
0032778 201. IF (ICE.EQ.3) GO TO 163
0033006 202. GO TO 126
0033016 203. 161 N51=N51+1
0033036 204. IF (IP.EQ.1) GO TO 164
0033056 205. GO TO 126
0033096 206. 164 N52=N52+1
0033078 207. X21=X21+PA

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0033160 208. 50 TO 126
0033115 209. 162 N53=N53+1
0033135 210. IF (IP.EQ.1) GO TO 165
0033150 211. GO TO 126
0033155 212. 165 N54=N54+1
0033170 213. X22=X22+PA
0033200 214. GO TO 126
0033210 215. 163 N55=N55+1
0033238 216. IF (IP.EQ.1) GO TO 166
0033250 217. GO TO 126
0033255 218. 166 N56=N56+1
0033270 219. X23=X23+PA
0033300 220. GO TO 126
C * * * * *
C * * * * *
C * * * * *
DISTRICT 6 ANALYSIS
C * * * * *
0033310 221. 125 N57=N57+1
0033330 222. IF (IP.EQ.1) GO TO 167
0033350 223. GO TO 168
0033355 224. 167 N58=N58+1
0033370 225. X24=X24+PA
0033400 226. 168 IF (ICE.EQ.1) GO TO 169
0033420 227. IF (ICE.EQ.2) GO TO 170
0033440 228. IF (ICE.EQ.3) GO TO 171
0033450 229. GO TO 126
0033463 230. 169 N59=N59+1
0033500 231. IF (IP.EQ.1) GO TO 172
0033520 232. GO TO 126
0033525 233. 172 N60=N60+1
0033540 234. X25=X25+PA
0033550 235. GO TO 126
0033560 236. 170 N61=N61+1
0033600 237. IF (IP.EQ.1) GO TO 173
0033620 238. GO TO 126
0033623 239. 173 N62=N62+1
0033640 240. X26=X26+PA
0033650 241. GO TO 126
0033663 242. 171 N63=N63+1
0033700 243. IF (IP.EQ.1) GO TO 174
0033720 244. GO TO 126
0033720 245. 174 N64=N64+1
0033740 246. X27=X27+PA
0033750 247. 126 GO TO 100
C * * * * *
C * * * * *
C * * * * *
THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE BRIDGE
CONTRACTS
C * * * * *
0033760 248. 104 M1=M1+1
0034000 249. IF (IP.EQ.1) GO TO 175
0034020 250. 50 TO 176
0034020 251. 175 M2=M2+1
0034040 252. Y=Y+PA
C * * * * *
C * * * * *
C * * * * *
THIS SECTION ANALYZES THE BRIDGE CONTRACTS BY CITY, COUNTY, OR
STATE PROJECT ENGINEER
C * * * * *
0034050 253. 176 IF (ICE.EQ.1) GO TO 177
0034070 254. IF (ICE.EQ.2) GO TO 178

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003411b 255. IF (ICE.EQ.3) GO TO 179
003412b 256. GO TO 180
003413b 257. 177 M11=M11+1
003415b 258. IF (IP.EQ.1) GO TO 181
003417b 259. GO TO 180
003417b 260. 181 M12=M12+1
003421b 261. Y1=Y1+PA
003422b 262. GO TO 180
003423b 263. 178 M13=M13+1
003425b 264. IF (IP.EQ.1) GO TO 182
003427b 265. GO TO 180
003427b 266. 182 M14=M14+1
003431b 267. Y2=Y2+PA
003432b 268. GO TO 180
003433b 269. 179 M15=M15+1
003435b 270. IF (IP.EQ.1) GO TO 183
003437b 271. GO TO 180
003437b 272. 183 M16=M16+1
003441b 273. Y3=Y3+PA
C * * * * *
C * THIS SECTION ANALYZES BRIDGE CONTRACTS BY DISTRICTS
C * * * * *
003442b 274. 180 IF (ID.EQ.1) GO TO 184
003444b 275. IF (ID.EQ.2) GO TO 185
003446b 276. IF (ID.EQ.3) GO TO 186
003447b 277. IF (ID.EQ.4) GO TO 187
003451b 278. IF (ID.EQ.5) GO TO 188
003452b 279. IF (ID.EQ.6) GO TO 189
003454b 280. GO TO 190
C * * * * *
C * DISTRICT ANALYSIS
C * * * * *
003455b 281. 184 M17=M17+1
003456b 282. IF (IP.EQ.1) GO TO 191
003460b 283. GO TO 192
003460b 284. 191 M18=M18+1
003462b 285. Y4=Y4+PA
003463b 286. 192 IF (ICE.EQ.1) GO TO 193
003465b 287. IF (ICE.EQ.2) GO TO 194
003467b 288. IF (ICE.EQ.3) GO TO 195
003470b 289. GO TO 190
003471b 290. 193 M19=M19+1
003473b 291. IF (IP.EQ.1) GO TO 196
003475b 292. GO TO 190
003475b 293. 196 M20=M20+1
003477b 294. Y5=Y5+PA
003500b 295. GO TO 190
003501b 296. 194 M21=M21+1
003503b 297. IF (IP.EQ.1) GO TO 197
003505b 298. GO TO 190
003505b 299. 197 M22=M22+1
003507b 300. Y6=Y6+PA
003510b 301. GO TO 190
003511b 302. 195 M23=M23+1
003513b 303. IF (IP.EQ.1) GO TO 198
003515b 304. GO TO 190
003515b 305. 198 M24=M24+1
003517b 306. Y7=Y7+PA

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003520b 307.      GO TO 190
C * * * * *
C * * * * * DISTRICT 2 ANALYSIS * * * * *
C * * * * *
003521b 308.      185 M25=M25+1
003523b 309.      IF (IP.EQ.1) GO TO 199
003525b 310.      GO TO 200
003525b 311.      199 M26=M26+1
003527b 312.      Y8=Y8+PA
003530b 313.      200 IF (ICE.EQ.1) GO TO 201
003532b 314.      IF (ICE.EQ.2) GO TO 202
003534b 315.      IF (ICE.EQ.3) GO TO 203
003535b 316.      GO TO 190
003536b 317.      201 M27=M27+1
003540b 318.      IF (IP.EQ.1) GO TO 204
003542b 319.      GO TO 190
003542b 320.      204 M28=M28+1
003544b 321.      Y9=Y9+PA
003546b 322.      GO TO 190
003546b 323.      202 M29=M29+1
003550b 324.      IF (IP.EQ.1) GO TO 205
003552b 325.      GO TO 190
003552b 326.      205 M30=M30+1
003554b 327.      Y10=Y10+PA
003555b 328.      GO TO 190
003556b 329.      203 M31=M31+1
003560b 330.      IF (IP.EQ.1) GO TO 206
003562b 331.      GO TO 190
003562b 332.      206 M32=M32+1
003564b 333.      Y11=Y11+PA
003565b 334.      GO TO 190
C * * * * *
C * * * * * DISTRICT 3 ANALYSIS * * * * *
C * * * * *
003566b 335.      186 M33=M33+1
003570b 336.      IF (IP.EQ.1) GO TO 207
003572b 337.      GO TO 208
003572b 338.      207 M34=M34+1
003574b 339.      Y12=Y12+PA
003575b 340.      208 IF (ICE.EQ.1) GO TO 209
003577b 341.      IF (ICE.EQ.2) GO TO 210
003580b 342.      IF (ICE.EQ.3) GO TO 211
003602b 343.      GO TO 190
003603b 344.      209 M35=M35+1
003605b 345.      IF (IP.EQ.1) GO TO 212
003607b 346.      GO TO 190
003607b 347.      212 M36=M36+1
003611b 348.      Y13=Y13+PA
003612b 349.      GO TO 190
003613b 350.      210 M37=M37+1
003615b 351.      IF (IP.EQ.1) GO TO 213
003617b 352.      GO TO 190
003617b 353.      213 M38=M38+1
003621b 354.      Y14=Y14+PA
003622b 355.      GO TO 190
003623b 356.      211 M39=M39+1
003625b 357.      IF (IP.EQ.1) GO TO 214
003627b 358.      GO TO 190

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0036270 359. 214 M40=M40+1
0036310 360. Y15=Y15+PA
0036320 361. GO TO 130
C * * * * *
C * * * * * DISTRICT 4 ANALYSIS * * * * *
C * * * * *
0036330 362. 187 M41=M41+1
0036353 363. IF (IP.EQ.1) GO TO 215
0036370 364. GO TO 216
0036370 365. 215 M42=M42+1
0036410 366. Y16=Y16+PA
0036420 367. 216 IF (ICE.EQ.1) GO TO 217
0036440 368. IF (ICE.EQ.2) GO TO 218
0036460 369. IF (ICE.EQ.3) GO TO 219
0036470 370. GO TO 190
0036503 371. 217 M43=M43+1
0036525 372. IF (IP.EQ.1) GO TO 220
0036540 373. GO TO 190
0036540 374. 220 M44=M44+1
0036560 375. Y17=Y17+PA
0036570 376. GO TO 190
0036600 377. 218 M45=M45+1
0036620 378. IF (IP.EQ.1) GO TO 221
0036640 379. GO TO 190
0036640 380. 221 M46=M46+1
0036660 381. Y18=Y18+PA
0036670 382. GO TO 190
0036700 383. 219 M47=M47+1
0036720 384. IF (IP.EQ.1) GO TO 222
0036740 385. GO TO 190
0036740 386. 222 M48=M48+1
0036760 387. Y19=Y19+PA
0036770 388. GO TO 190
C * * * * *
C * * * * * DISTRICT 5 ANALYSIS * * * * *
C * * * * *
0037000 389. 188 M49=M49+1
0037020 390. IF (IP.EQ.1) GO TO 223
0037040 391. GO TO 224
0037040 392. 223 M50=M50+1
0037060 393. Y20=Y20+PA
0037070 394. 224 IF (ICE.EQ.1) GO TO 225
0037110 395. IF (ICE.EQ.2) GO TO 226
0037130 396. IF (ICE.EQ.3) GO TO 227
0037140 397. GO TO 190
0037160 398. 225 M51=M51+1
0037170 399. IF (IP.EQ.1) GO TO 229
0037210 400. GO TO 190
0037210 401. 228 M52=M52+1
0037230 402. Y21=Y21+PA
0037240 403. GO TO 190
0037260 404. 226 M53=M53+1
0037270 405. IF (IP.EQ.1) GO TO 229
0037310 406. GO TO 190
0037310 407. 229 M54=M54+1
0037330 408. Y22=Y22+PA
0037340 409. GO TO 190
0037370 410. 227 M55=M55+1

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0037370 411. IF (IP.EQ.1) GO TO 230
0037410 412. GO TO 190
0037410 413. 230 M56=M56+1
0037430 414. Y23=Y23+PA
0037440 415. GO TO 190
C * * * * *
C * * * * * DISTRICT ANALYSIS * * * * *
C * * * * *
0037450 416. 189 M57=M57+1
0037470 417. IF (IP.EQ.1) GO TO 231
0037510 418. GO TO 232
0037510 419. 231 M58=M58+1
0037530 420. Y24=Y24+PA
0037540 421. 232 IF (ICE.EQ.1) GO TO 233
0037560 422. IF (ICE.EQ.2) GO TO 234
0037600 423. IF (ICE.EQ.3) GO TO 235
0037610 424. GO TO 190
0037620 425. 233 M59=M59+1
0037640 426. IF (IP.EQ.1) GO TO 236
0037660 427. GO TO 190
0037680 428. 236 M60=M60+1
0037700 429. Y25=Y25+PA
0037710 430. GO TO 190
0037720 431. 234 M61=M61+1
0037740 432. IF (IP.EQ.1) GO TO 237
0037760 433. GO TO 190
0037780 434. 237 M62=M62+1
0040000 435. Y26=Y26+PA
0040010 436. GO TO 190
0040020 437. 235 M63=M63+1
0040040 438. IF (IP.EQ.1) GO TO 238
0040060 439. GO TO 190
0040080 440. 238 M64=M64+1
0040100 441. Y27=Y27+PA
0040110 442. 190 GO TO 100
C * * * * *
C * * * * * THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE ROAD*TRAFFIC
C * * * * * CONTRACTS * * * * *
C * * * * *
0040120 443. 105 L1=L1+1
0040140 444. IF (IP.EQ.1) GO TO 239
0040160 445. GO TO 240
0040180 446. 239 L2=L2+1
0040200 447. Z=Z+PA
C * * * * *
C * * * * * THIS SECTION ANALYZES THE ROAD*TRAFFIC CONTRACTS BY CITY,
C * * * * * COUNTY, OR STATE PROJECT ENGINEER * * * * *
C * * * * *
0040210 448. 240 IF (ICE.EQ.1) GO TO 241
0040230 449. IF (ICE.EQ.2) GO TO 242
0040250 450. IF (ICE.EQ.3) GO TO 243
0040260 451. GO TO 244
0040270 452. 241 L11=L11+1
0040310 453. IF (IP.EQ.1) GO TO 245
0040330 454. GO TO 244
0040350 455. 245 L12=L12+1
0040360 456. Z1=Z1+PA
0040380 457. GO TO 244

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0040376 458. 242 L13=L13+1/
0040416 459. IF (IP.EQ.1) GO TO 246
0040436 460. GO TO 244
0040436 461. 246 L14=L14+1
0040456 462. Z2=Z2+PA
0040466 463. GO TO 244
0040476 464. 243 L15=L15+1
0040513 465. IF (IP.EQ.1) GO TO 247
0040536 466. GO TO 244
0040533 467. 247 L16=L16+1
0040556 468. Z3=Z3+PA
C * * * * *
C THIS SECTION ANALYZES ROAD-TRAFFIC CONTRACTS BY DISTRICT
C * * * * *
0040566 469. 244 IF (ID.EQ.1) GO TO 248
0040609 470. IF (ID.EQ.2) GO TO 249
0040620 471. IF (ID.EQ.3) GO TO 250
0040636 472. IF (ID.EQ.4) GO TO 251
0040658 473. IF (ID.EQ.5) GO TO 252
0040668 474. IF (ID.EQ.6) GO TO 253
0040706 475. GO TO 254
C * * * * *
C DISTRICT 1 ANALYSIS
C * * * * *
0040716 476. 248 L17=L17+1
0040724 477. IF (IP.EQ.1) GO TO 255
0040743 478. GO TO 256
0040746 479. 255 L18=L18+1
0040765 480. Z4=Z4+PA
0040773 481. 256 IF (ICE.EQ.1) GO TO 257
0041013 482. IF (ICE.EQ.2) GO TO 258
0041036 483. IF (ICE.EQ.3) GO TO 259
0041046 484. GO TO 254
0041053 485. 257 L19=L19+1
0041073 486. IF (IP.EQ.1) GO TO 260
0041116 487. GO TO 254
0041116 488. 260 L20=L20+1
0041133 489. Z5=Z5+PA
0041146 490. GO TO 254
0041156 491. 258 L21=L21+1
0041176 492. IF (IP.EQ.1) GO TO 261
0041216 493. GO TO 254
0041216 494. 261 L22=L22+1
0041236 495. Z6=Z6+PA
0041246 496. GO TO 254
0041256 497. 259 L23=L23+1
0041276 498. IF (IP.EQ.1) GO TO 262
0041316 499. GO TO 254
0041313 500.
0041316 501. 262 L24=L24+1
0041336 501. Z7=Z7+PA
0041346 502. GO TO 254
C * * * * *
C DISTRICT 2 ANALYSIS
C * * * * *
0041356 503. 249 L25=L25+1
0041376 504. IF (IP.EQ.1) GO TO 263
0041416 505. GO TO 254

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004141E 506. 263 L26=L26+1
004143E 507. Z8=Z8+PA
004144E 508. 264 IF (ICE.EQ.1) GO TO 265
004146E 509. IF (ICE.EQ.2) GO TO 266
004150E 510. IF (ICE.EQ.3) GO TO 267
004151E 511. GO TO 254
004152E 512. 265 L27=L27+1
004154E 513. IF (IP.EQ.1) GO TO 268
004156E 514. GO TO 254
004158E 515. 268 L28=L28+1
004162E 516. Z9=Z9+PA
004164E 517. GO TO 254
004166E 518. 266 L29=L29+1
004168E 519. IF (IP.EQ.1) GO TO 269
00416AE 520. GO TO 254
00416CE 521. 269 L30=L30+1
004170E 522. Z10=Z10+PA
004172E 523. GO TO 254
004174E 524. 267 L31=L31+1
004176E 525. IF (IP.EQ.1) GO TO 270
004178E 526. GO TO 254
00417AE 527. 276 L32=L32+1
004200E 528. Z11=Z11+PA
004202E 529. GO TO 254

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C * * * * *
C DISTRICT 3 ANALYSIS
C * * * * *

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004202E 530. 250 L33=L33+1
004204E 531. IF (IP.EQ.1) GO TO 271
004206E 532. GO TO 272
004208E 533. 271 L34=L34+1
004210E 534. Z12=Z12+PA
004212E 535. 272 IF (ICE.EQ.1) GO TO 273
004214E 536. IF (ICE.EQ.2) GO TO 274
004216E 537. IF (ICE.EQ.3) GO TO 275
004218E 538. GO TO 254
00421AE 539. 273 L35=L35+1
004220E 540. IF (IP.EQ.1) GO TO 276
004222E 541. GO TO 254
004224E 542. 276 L36=L36+1
004226E 543. Z13=Z13+PA
004228E 544. GO TO 254
00422AE 545. 274 L37=L37+1
004230E 546. IF (IP.EQ.1) GO TO 277
004232E 547. GO TO 254
004234E 548. 277 L38=L38+1
004236E 549. Z14=Z14+PA
004238E 550. GO TO 254
00423AE 551. 275 L39=L39+1
004240E 552. IF (IP.EQ.1) GO TO 278
004242E 553. GO TO 254
004244E 554. 278 L40=L40+1
004246E 555. Z15=Z15+PA
004248E 556. GO TO 254

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C * * * * *
C DISTRICT 4 ANALYSIS
C * * * * *

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004247E 557. 251 L41=L41+1

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004251c 554. IF (IP.EQ.1) GO TO 279
004253c 559. GO TO 280
004253c 560. 279 L42=L42+1
004255c 561. Z16=Z16+PA
004256c 562. 280 IF (ICE.EQ.1) GO TO 281
004260c 563. IF (ICE.EQ.2) GO TO 282
004262c 564. IF (ICE.EQ.3) GO TO 283
004263c 565. GO TO 254
004264c 565. 281 L43=L43+1
004265c 567. IF (IP.EQ.1) GO TO 284
004270c 568. GO TO 254
004270c 569. 284 L44=L44+1
004272c 570. Z17=Z17+PA
004273c 571. GO TO 254
004274c 572. 282 L45=L45+1
004276c 573. IF (IP.EQ.1) GO TO 285
004300c 574. GO TO 254
004300c 575. 285 L46=L46+1
004302c 576. Z18=Z18+PA
004303c 577. GO TO 254
004304c 578. 283 L47=L47+1
004306c 579. IF (IP.EQ.1) GO TO 286
004310c 580. GO TO 254
004310c 581. 286 L48=L48+1
004312c 582. Z19=Z19+PA
004313c 583. GO TO 254
C * * * * *
C DISTRICT 5 ANALYSIS
C * * * * *
004314c 584. 252 L49=L49+1
004315c 585. IF (IP.EQ.1) GO TO 287
004320c 586. GO TO 288
004320c 587. 287 L50=L50+1
004322c 588. Z20=Z20+PA
004323c 589. 288 IF (ICE.EQ.1) GO TO 289
004325c 590. IF (ICE.EQ.2) GO TO 290
004327c 591. IF (ICE.EQ.3) GO TO 291
004330c 592. GO TO 254
004331c 593. 289 L51=L51+1
004333c 594. IF (IP.EQ.1) GO TO 292
004335c 595. GO TO 254
004335c 596. 292 L52=L52+1
004337c 597. Z21=Z21+PA
004340c 598. GO TO 254
004341c 599. 290 L53=L53+1
004343c 600. IF (IP.EQ.1) GO TO 293
004345c 601. GO TO 254
004345c 602. 293 L54=L54+1
004347c 603. Z22=Z22+PA
004350c 604. GO TO 254
004351c 605. 291 L55=L55+1
004353c 606. IF (IP.EQ.1) GO TO 294
004353c 607. GO TO 254
004355c 608. 294 L56=L56+1
004357c 609. Z23=Z23+PA
004360c 610. GO TO 254
C * * * * *
C DISTRICT 6 ANALYSIS

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C * * * * *
0043610 611. 253 L57=L57+1
0043635 612. IF (IP.EQ.1) GO TO 295
0043650 613. GO TO 296
0043653 614. 295 L58=L58+1
0043676 615. Z24=Z24+PA
0043703 616. 296 IF (ICE.EQ.1) GO TO 247
0043726 617. IF (ICE.EQ.2) GO TO 298
0043740 618. IF (ICE.EQ.3) GO TO 299
0043756 619. GO TO 254
0043761 620. 297 L59=L59+1
0044003 621. IF (IP.EQ.1) GO TO 300
0044026 622. GO TO 254
0044023 623. 300 L60=L60+1
0044046 624. Z25=Z25+PA
0044053 625. GO TO 254
0044066 626. 298 L61=L61+1
0044130 627. IF (IP.EQ.1) GO TO 301
0044126 628. GO TO 254
0044126 629. 301 L62=L62+1
0044140 630. Z26=Z26+PA
0044150 631. GO TO 254
0044163 632. 299 L63=L63+1
0044203 633. IF (IP.EQ.1) GO TO 302
0044226 634. GO TO 254
0044223 635. 302 L64=L64+1
0044246 636. Z27=Z27+PA
0044251 637. 254 GO TO 100
C * * * * *
C THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE ROAD SURFACING
C CONTRACTS
C * * * * *
0044265 638. 106 K1=K1+1
0044300 639. IF (IP.EQ.1) GO TO 303
0044326 640. GO TO 304
0044326 641. 303 K2=K2+1
0044340 642. V=V+PA
C * * * * *
C THIS SECTION ANALYZES THE ROAD SURFACING CONTRACTS BY CITY,
C COUNTY, OR STATE PROJECT ENGINEER
C * * * * *
0044350 643. 304 IF (ICE.EQ.1) GO TO 305
0044376 644. IF (ICE.EQ.2) GO TO 306
0044413 645. IF (ICE.EQ.3) GO TO 307
0044416 646.
0044426 647. GO TO 308
0044438 647. 305 K11=K11+1
0044453 648. IF (IP.EQ.1) GO TO 309
0044478 649. GO TO 308
0044478 650. 309 K12=K12+1
0044510 651. V1=V1+PA
0044526 652. GO TO 308
0044533 653. 306 K13=K13+1
0044558 654. IF (IP.EQ.1) GO TO 310
0044576 655. GO TO 308
0044576 656. 310 K14=K14+1
0044613 657. V2=V2+PA
0044620 658. GO TO 308

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004463E 659. 307 K15=K15+1
004465E 660. IF (IP.EQ.1) GO TO 311
0044673 661. GO TO 308
004467D 662. 311 K16=K16+1
004471E 663. V3=V3+PA
C * * * * *
C THIS SECTION ANALYZES ROAD SURFACING CONTRACTS BY DISTRICTS
C * * * * *
004472B 664. 308 IF (IO.EQ.1) GO TO 312
004474C 665. IF (IO.EQ.2) GO TO 313
004476B 666. IF (IO.EQ.3) GO TO 314
0044775 667. IF (IO.EQ.4) GO TO 315
004501E 668. IF (IO.EQ.5) GO TO 316
0045023 669. IF (IO.EQ.6) GO TO 317
004504D 670. GO TO 318
C * * * * *
C DISTRICT 1 ANALYSIS
C * * * * *
004509E 671. 312 K17=K17+1
004509E 672. IF (IP.EQ.1) GO TO 319
004510E 673. GO TO 320
004510E 674. 319 K18=K18+1
004512E 675. V4=V4+PA
0045133 676. 320 IF (ICE.EQ.1) GO TO 321
004517E 677. IF (ICE.EQ.2) GO TO 322
0045173 678. IF (ICE.EQ.3) GO TO 323
004520E 679. GO TO 318
004521D 680. 321 K19=K19+1
004523D 681. IF (IP.EQ.1) GO TO 324
004525E 682. GO TO 318
004525E 683. 324 K20=K20+1
004527E 684. V5=V5+PA
0045303 685. GO TO 318
004531B 686. 322 K21=K21+1
004533B 687. IF (IP.EQ.1) GO TO 325
004535D 688. GO TO 318
0045353 689. 325 K22=K22+1
0045373 690. V6=V6+PA
004540B 691. GO TO 318
004541D 692. 323 K23=K23+1
004543E 693. IF (IP.EQ.1) GO TO 326
004545D 694. GO TO 318
004547B 695. 326 K24=K24+1
004547E 696. V7=V7+PA
004550B 697. GO TO 318
C * * * * *
C DISTRICT 2 ANALYSIS
C * * * * *
004551B 698. 313 K25=K25+1
0045533 699. IF (IP.EQ.1) GO TO 327
004555E 700. GO TO 328
0045553 701. 327 K26=K26+1
0045576 702. V8=V8+PA
004560E 703. 328 IF (ICE.EQ.1) GO TO 329
004562E 704. IF (ICE.EQ.2) GO TO 330
004564B 705. IF (ICE.EQ.3) GO TO 331
004566B 706. GO TO 318
0045663 707. 329 K27=K27+1

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004570b 709.      IF (IP.EQ.1) GO TO 332
004572b 709.      GO TO 318
004574b 710.      332 K28=K28+1
004576b 711.      V9=V9+PA
004578b 712.      GO TO 318
004580b 713.      330 K29=K29+1
004600c 714.      IF (IP.EQ.1) GO TO 333
004602c 715.      GO TO 318
004604c 716.      333 K30=K30+1
004606b 717.      V10=V10+PA
004608b 718.      GO TO 318
004610b 719.      331 K31=K31+1
004612b 720.      IF (IP.EQ.1) GO TO 334
004614b 721.      GO TO 318
004616b 722.      334 K32=K32+1
004618b 723.      V11=V11+PA
004620b 724.      GO TO 318
C * * * * *
C * * * * * DISTRICT 3 ANALYSIS * * * * *
C * * * * *
004620b 725.      314 K33=K33+1
004622b 726.      IF (IP.EQ.1) GO TO 335
004624b 727.      GO TO 336
004626b 728.      335 K34=K34+1
004628b 729.      V12=V12+PA
004630b 730.      336 IF (ICE.EQ.1) GO TO 337
004632b 731.      IF (ICE.EQ.2) GO TO 338
004634b 732.      IF (ICE.EQ.3) GO TO 339
004636b 733.      GO TO 318
004638b 734.      337 K35=K35+1
004640b 735.      IF (IP.EQ.1) GO TO 340
004642b 736.      GO TO 318
004644b 737.      340 K36=K36+1
004646b 738.      V13=V13+PA
004648b 739.      GO TO 318
004650b 740.      338 K37=K37+1
004652b 741.      IF (IP.EQ.1) GO TO 341
004654b 742.      GO TO 318
004656b 743.      341 K38=K38+1
004658b 744.      V14=V14+PA
004660b 745.      GO TO 318
004662b 746.      339 K39=K39+1
004664b 747.      IF (IP.EQ.1) GO TO 342
004666b 748.      GO TO 318
004668b 749.      342 K40=K40+1
004670b 750.      V15=V15+PA
004672b 751.      GO TO 318
C * * * * *
C * * * * * DISTRICT 4 ANALYSIS * * * * *
C * * * * *
004670b 752.      315 K41=K41+1
004672b 753.      IF (IP.EQ.1) GO TO 343
004674b 754.      GO TO 344
004676b 755.      343 K42=K42+1
004678b 756.      V16=V16+PA
004680b 757.      344 IF (ICE.EQ.1) GO TO 345
004682b 758.      IF (ICE.EQ.2) GO TO 346
004684b 759.      IF (ICE.EQ.3) GO TO 347

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0046776 760. GO TO 318
0047006 761. 345 K43=K43+1
0047026 762. IF (IP.EQ.1) GO TO 348
0047046 763. GO TO 318
0047046 764. 348 K44=K44+1
0047066 765. V17=V17+PA
0047076 766. GO TO 318
0047106 767. 346 K45=K45+1
0047126 768. IF (IP.EQ.1) GO TO 349
0047143 769. GO TO 318
0047146 770. 349 K46=K46+1
0047166 771. V18=V18+PA
0047178 772. GO TO 318
0047208 773. 347 K47=K47+1
0047228 774. IF (IP.EQ.1) GO TO 350
0047246 775. GO TO 318
0047246 776. 350 K48=K48+1
0047266 777. V19=V19+PA
0047276 778. GO TO 318
C * * * * *
C * * * * * DISTRICT 5 ANALYSIS * * * * *
C * * * * *
0047306 779. 316 K49=K49+1
0047326 780. IF (IP.EQ.1) GO TO 351
0047343 781. GO TO 352
0047346 782. 351 K50=K50+1
0047366 783. V20=V20+PA
0047376 784. 352 IF (ICE.EQ.1) GO TO 353
0047416 785. IF (ICE.EQ.2) GO TO 354
0047436 786. IF (ICE.EQ.3) GO TO 355
0047446 787. GO TO 318
0047456 788. 353 K51=K51+1
0047476 789. IF (IP.EQ.1) GO TO 356
0047516 790. GO TO 318
0047516 791. 356 K52=K52+1
0047536 792. V21=V21+PA
0047546 793. GO TO 318
0047556 794. 354 K53=K53+1
0047576 795. IF (IP.EQ.1) GO TO 357
0047616 796. GO TO 318
0047616 797. 357 K54=K54+1
0047636 798. V22=V22+PA
0047646 799. GO TO 318
0047656 800. 355 K55=K55+1
0047676 801. IF (IP.EQ.1) GO TO 358
0047716 802. GO TO 318
0047716 803. 358 K56=K56+1
0047736 804. V23=V23+PA
0047746 805. GO TO 318
C * * * * *
C * * * * * DISTRICT 6 ANALYSIS * * * * *
C * * * * *
0047756 806. 317 K57=K57+1
0047776 807. IF (IP.EQ.1) GO TO 359
0050016 808. GO TO 360
0050016 809. 359 K58=K58+1
0050036 810. V24=V24+PA
0050046 811. 360 IF (ICE.EQ.1) GO TO 361

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005006L 812. IF (ICE.EQ.2) GO TO 362
005010L 813. IF (ICE.EQ.3) GO TO 363
005011L 814. GO TO 318
005012L 815. 361 K59=K59+1
005014L 816. IF (IP.EQ.1) GO TO 364
005016L 817. GO TO 318
005016L 818. 364 K60=K60+1
005020L 819. V25=V25+PA
005021L 820. GO TO 318
005022L 821. 362 K61=K61+1
005024L 822. IF (IP.EQ.1) GO TO 365
005026L 823. GO TO 318
005026L 824. 365 K62=K62+1
005030L 825. V26=V26+PA
005031L 826. GO TO 318
005032L 827. 363 K63=K63+1
005034L 828. IF (IP.EQ.1) GO TO 366
005036L 829. GO TO 318
005036L 830. 366 K64=K64+1
005040L 831. V27=V27+PA
005041L 832. 318 GO TO 100
C * * * * *
C THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE
C ROAD*MAINTENANCE CONTRACTS
C * * * * *
005042L 833. 107 J1=J1+1
005044L 834. IF (IP.EQ.1) GO TO 367
005046L 835. GO TO 368
005046L 836. 367 J2=J2+1
005050L 837. U=U+PA
C * * * * *
C THIS SECTION ANALYZES THE ROAD*MAINTENANCE CONTRACTS BY CITY,
C COUNTY, OR STATE PROJECT ENGINEER
C * * * * *
005051L 838. 368 IF (ICE.EQ.1) GO TO 369
005053L 839. IF (ICE.EQ.2) GO TO 370
005055L 840. IF (ICE.EQ.3) GO TO 371
005056L 841. GO TO 372
005057L 842. 369 J11=J11+1
005061L 843. IF (IP.EQ.1) GO TO 373
005063L 844. GO TO 372
005063L 845. 373 J12=J12+1
005065L 846. U1=U1+PA
005066L 847. GO TO 372
005067L 848. 370 J13=J13+1
005071L 849. IF (IP.EQ.1) GO TO 374
005073L 850. GO TO 372
005073L 851. 374 J14=J14+1
005075L 852. U2=U2+PA
005076L 853. GO TO 372
005077L 854. 371 J15=J15+1
005101L 855. IF (IP.EQ.1) GO TO 375
005103L 856. GO TO 372
005103L 857. 375 J16=J16+1
005105L 858. J3=U3+PA
C * * * * *
C THIS SECTION ANALYZES ROAD*MAINTENANCE CONTRACTS BY DISTRICTS
C * * * * *

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0051066 859. 372 IF (ID.EQ.1) GO TO 376
0051106 860. IF (ID.EQ.2) GO TO 377
0051126 861. IF (ID.EQ.3) GO TO 378
0051138 862. IF (ID.EQ.4) GO TO 379
0051159 863. IF (ID.EQ.5) GO TO 380
0051168 864. IF (ID.EQ.6) GO TO 381
0051203 865. GO TO 382

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C * * * * *
C * * * * * DISTRICT 1 ANALYSIS * * * * *
C * * * * *

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0051216 866. 376 J17=J17+1
0051228 867. IF (IP.EQ.1) GO TO 383
0051246 868. GO TO 384
0051248 869. 383 J18=J18+1
0051266 870. U4=U4+PA
0051276 871. 384 IF (ICE.EQ.1) GO TO 385
0051316 872. IF (ICE.EQ.2) GO TO 386
0051338 873. IF (ICE.EQ.3) GO TO 387
0051346 874. GO TO 382
0051353 875. 385 J19=J19+1
0051376 876. IF (IP.EQ.1) GO TO 388
0051416 877. GO TO 382
0051416 878. 388 J20=J20+1
0051434 879. U5=U5+PA
0051446 880. GO TO 382
0051456 881. 386 J21=J21+1
0051476 882. IF (IP.EQ.1) GO TO 389
0051516 883. GO TO 382
0051516 884. 389 J22=J22+1
0051536 885. U6=U6+PA
0051548 886. GO TO 382
0051556 887. 387 J23=J23+1
0051576 888. IF (IP.EQ.1) GO TO 390
0051616 889. GO TO 382
0051616 890. 390 J24=J24+1
0051636 891. U7=U7+PA
0051646 892. GO TO 382

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C * * * * *
C * * * * * DISTRICT 2 ANALYSIS * * * * *
C * * * * *

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0051656 893. 377 J25=J25+1
0051676 894. IF (IP.EQ.1) GO TO 391
0051716 895. GO TO 392
0051716 896. 391 J26=J26+1
0051736 897. U8=U8+PA
0051746 898. 392 IF (ICE.EQ.1) GO TO 393
0051766 899. IF (ICE.EQ.2) GO TO 394
0052006 900. IF (ICE.EQ.3) GO TO 395
0052016 901. GO TO 382
0052026 902. 393 J27=J27+1
0052046 903. IF (IP.EQ.1) GO TO 396
0052066 904. GO TO 382
0052066 905. 396 J28=J28+1
0052106 906. U9=U9+PA
0052116 907. GO TO 382
0052126 908. 394 J29=J29+1
0052146 909. IF (IP.EQ.1) GO TO 397
0052166 910. GO TO 382

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0052160      911.      397 J30=J30+1
0052208      912.      U10=U10+PA
0052216      913.      GO TO 382
0052223      914.      395 J31=J31+1
0052248      915.      IF (IP.EQ.1) GO TO 398
0052268      916.      GO TO 382
0052268      917.      398 J32=J32+1
0052306      918.      U11=U11+PA
0052316      919.      GO TO 382
C * * * * *
C * * * * * DISTRICT 3 ANALYSIS * * * * *
C * * * * *
0052326      920.      378 J33=J33+1
0052346      921.      IF (IP.EQ.1) GO TO 399
0052366      922.      GO TO 400
0052366      923.      399 J34=J34+1
0052406      924.      U12=U12+PA
0052416      925.      400 IF (ICE.EQ.1) GO TO 401
0052438      926.      IF (ICE.EQ.2) GO TO 402
0052453      927.      IF (ICE.EQ.3) GO TO 403
0052468      928.      GO TO 382
0052476      929.      401 J35=J35+1
0052516      930.      IF (IP.EQ.1) GO TO 404
0052533      931.      GO TO 382
0052538      932.      404 J36=J36+1
0052556      933.      U13=U13+PA
0052566      934.      GO TO 382
0052578      935.      402 J37=J37+1
0052618      936.      IF (IP.EQ.1) GO TO 405
0052633      937.      GO TO 382
0052635      938.      405 J38=J38+1
0052658      939.      U14=U14+PA
0052666      940.      GO TO 382
0052675      941.      403 J39=J39+1
0052718      942.      IF (IP.EQ.1) GO TO 406
0052738      943.      GO TO 382
0052738      944.      406 J40=J40+1
0052753      945.      U15=U15+PA
0052768      946.      GO TO 382
C * * * * *
C * * * * * DISTRICT 4 ANALYSIS * * * * *
C * * * * *
0052778      947.      379 J41=J41+1
0053018      948.      IF (IP.EQ.1) GO TO 407
0053038      949.      GO TO 408
0053038      950.      407 J42=J42+1
0053058      951.      U16=U16+PA
0053068      952.      408 IF (ICE.EQ.1) GO TO 409
0053103      953.      IF (ICE.EQ.2) GO TO 410
0053126      954.      IF (ICE.EQ.3) GO TO 411
0053136      955.      GO TO 382
0053148      956.      409 J43=J43+1
0053168      957.      IF (IP.EQ.1) GO TO 412
0053208      958.      GO TO 382
0053208      959.      412 J44=J44+1
0053228      960.      U17=U17+PA
0053238      961.      GO TO 382
0053246      962.      410 J45=J45+1

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005326b 963. IF (IP.EQ.1) GO TO 413
005330b 964. GO TO 382
005330j 965. 413 J46=J46+1
005332b 966. U18=U18+PA
005333b 967. GO TO 382
005334b 968. 411 J47=J47+1
005336b 969. IF (IP.EQ.1) GO TO 414
005340b 970. GO TO 382
005340b 971. 414 J48=J48+1
005342b 972. U19=U19+PA
005343b 973. GO TO 382
C * * * * *
C DISTRICT ANALYSIS
C * * * * *
005344b 974. 380 J49=J49+1
005346b 975. IF (IP.EQ.1) GO TO 415
005350b 976. GO TO 416
005350b 977. 415 J50=J50+1
005352b 978. U20=U20+PA
005353b 979. 416 IF (ICE.EQ.1) GO TO 417
005355b 980. IF (ICE.EQ.2) GO TO 418
005357b 981. IF (ICE.EQ.3) GO TO 419
005360b 982. GO TO 382
005361b 983. 417 J51=J51+1
005363b 984. IF (IP.EQ.1) GO TO 420
005365b 985. GO TO 382
005365b 986. 420 J52=J52+1
005367b 987. U21=U21+PA
005370b 988. GO TO 382
005371b 989. 418 J53=J53+1
005373b 990. IF (IP.EQ.1) GO TO 421
005375b 991. GO TO 382
005375b 992. 421 J54=J54+1
005377b 993. U22=U22+PA
005400b 994. GO TO 382
005401b 995. 419 J55=J55+1
005403b 996. IF (IP.EQ.1) GO TO 422
005405b 997. GO TO 382
005405b 998. 422 J56=J56+1
005407b 999. U23=U23+PA
005410b 1000. GO TO 382
C * * * * *
C DISTRICT 6 ANALYSIS
C * * * * *
005411b 1001. 381 J57=J57+1
005413b 1002. IF (IP.EQ.1) GO TO 423
005415b 1003. GO TO 424
005415b 1004. 423 J58=J58+1
005417b 1005. U24=U24+PA
005420b 1006. 424 IF (ICE.EQ.1) GO TO 425
005422b 1007. IF (ICE.EQ.2) GO TO 426
005424b 1008. IF (ICE.EQ.3) GO TO 427
005425b 1009. GO TO 382
005425b 1010. 425 J59=J59+1
005430b 1011. IF (IP.EQ.1) GO TO 428
005432b 1012. GO TO 382
005432b 1013. 428 J60=J60+1
005434b 1014. U25=U25+PA

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0054350 1015. GO TO 382
0054360 1016. 426 J01=J01+1
0054400 1017. IF (IP.EQ.1) GO TO 429
0054420 1018. GO TO 382
0054428 1019. 429 J02=J02+1
0054446 1020. U26=U26+PA
0054450 1021. GO TO 382
0054460 1022. 427 J03=J03+1
0054508 1023. IF (IP.EQ.1) GO TO 430
0054528 1024. GO TO 382
0054526 1025. 430 J04=J04+1
0054548 1026. U27=U27+PA
0054550 1027. 382 GO TO 100
0054566 1028. 999 NR=(N2*100)/N1
0054620 1029. NR1=(N12*100)/N11
0054660 1030. NR2=(N14*100)/N13
0054710 1031. NR3=(N16*100)/N15
0054750 1032. NR4=(N18*100)/N17
0055000 1033. NR5=(N20*100)/N19
0055040 1034. NR6=(N22*100)/N21
0055070 1035. NR7=(N24*100)/N23
0055130 1036. NR8=(N26*100)/N25
0055160 1037. NR9=(N28*100)/N27
0055220 1038. NR10=(N30*100)/N29
0055250 1039. NR11=(N32*100)/N31
0055310 1040. NR12=(N34*100)/N33
0055340 1041. NR13=(N36*100)/N35
0055400 1042. NR14=(N38*100)/N37
0055430 1043. NR15=(N40*100)/N39
0055470 1044. NR16=(N42*100)/N41
0055520 1045. NR17=(N44*100)/N43
0055560 1046. NR18=(N46*100)/N45
0055610 1047. NR19=(N48*100)/N47
0055650 1048. NR20=(N50*100)/N49
0055700 1049. NR21=(N52*100)/N51
0055740 1050. NR22=(N54*100)/N53
0055770 1051. NR23=(N56*100)/N55
0056030 1052. NR24=(N58*100)/N57
0056060 1053. NR25=(N60*100)/N59
0056120 1054. NR26=(N62*100)/N61
0056150 1055. NR27=(N64*100)/N63
0056210 1056. MR=(M2*100)/M1
0056240 1057. MR1=(M12*100)/M11
0056300 1058. MR2=(M14*100)/M13
0056330 1059. MR3=(M16*100)/M15
0056370 1060. MR4=(M18*100)/M17
0056420 1061. MR5=(M20*100)/M19
0056460 1062. MR6=(M22*100)/M21
0056510 1063. MR7=(M24*100)/M23
0056550 1064. MR8=(M26*100)/M25
0056600 1065. MR9=(M28*100)/M27
0056640 1066. MR10=(M30*100)/M29
0056670 1067. MR11=(M32*100)/M31
0056730 1068. MR12=(M34*100)/M33
0056760 1069. MR13=(M36*100)/M35
0057020 1070. MR14=(M38*100)/M37
0057050 1071. MR15=(M40*100)/M39
0057110 1072. MR16=(M42*100)/M41

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005714b	1073.	M217=(M44*100)/M43
005720b	1074.	M218=(M46*100)/M45
005723b	1075.	M219=(M48*100)/M47
005727b	1076.	M220=(M50*100)/M49
005732b	1077.	M221=(M52*100)/M51
005736b	1078.	M222=(M54*100)/M53
005741b	1079.	M223=(M56*100)/M55
005745b	1080.	M224=(M58*100)/M57
005750b	1081.	M225=(M60*100)/M59
005754b	1082.	M226=(M62*100)/M61
005757b	1083.	M227=(M64*100)/M63
005763b	1084.	LR=(L2*100)/L1
005766b	1085.	LR1=(L12*100)/L11
005772b	1086.	LR2=(L14*100)/L13
005775b	1087.	LR3=(L16*100)/L15
006001b	1088.	LR4=(L18*100)/L17
006004b	1089.	LR5=(L20*100)/L19
006010b	1090.	LR6=(L22*100)/L21
006013b	1091.	LR7=(L24*100)/L23
006017b	1092.	LR8=(L26*100)/L25
006022b	1093.	LR9=(L28*100)/L27
006026b	1094.	LR10=(L30*100)/L29
006031b	1095.	LR11=(L32*100)/L31
006035b	1096.	LR12=(L34*100)/L33
006040b	1097.	LR13=(L36*100)/L35
006044b	1098.	LR14=(L38*100)/L37
006047b	1099.	LR15=(L40*100)/L39
006053b	1100.	LR16=(L42*100)/L41
006056b	1101.	LR17=(L44*100)/L43
006062b	1102.	LR18=(L46*100)/L45
006065b	1103.	LR19=(L48*100)/L47
006071b	1104.	LR20=(L50*100)/L49
006074b	1105.	LR21=(L52*100)/L51
006100b	1106.	LR22=(L54*100)/L53
006103b	1107.	LR23=(L56*100)/L55
006107b	1108.	LR24=(L58*100)/L57
006112b	1109.	LR25=(L60*100)/L59
006116b	1110.	LR26=(L62*100)/L61
006121b	1111.	LR27=(L64*100)/L63
006125b	1112.	KR=(K2*100)/K1
006130b	1113.	KR1=(K12*100)/K11
006134b	1114.	KR2=(K14*100)/K13
006137b	1115.	KR3=(K16*100)/K15
006143b	1116.	KR4=(K18*100)/K17
006146b	1117.	KR5=(K20*100)/K19
006152b	1118.	KR6=(K22*100)/K21
006155b	1119.	KR7=(K24*100)/K23
006161b	1120.	KR8=(K26*100)/K25
006164b	1121.	KR9=(K28*100)/K27
006170b	1122.	KR10=(K30*100)/K29
006173b	1123.	KR11=(K32*100)/K31
006177b	1124.	KR12=(K34*100)/K33
006202b	1125.	KR13=(K36*100)/K35
006206b	1126.	KR14=(K38*100)/K37
006211b	1127.	KR15=(K40*100)/K39
006215b	1128.	KR16=(K42*100)/K41
006220b	1129.	KR17=(K44*100)/K43
006224b	1130.	KR18=(K46*100)/K45


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006227B 1131. KR19=(K48*100)/K47
006233B 1132. KR20=(K50*100)/K49
006236J 1133. KR21=(K52*100)/K51
006242B 1134. KR22=(K54*100)/K53
006245B 1135. KR23=(K56*100)/K55
006251E 1136. KR24=(K58*100)/K57
006254B 1137. KR25=(K60*100)/K59
006260B 1138. KR26=(K62*100)/K61
006263B 1139. KR27=(K64*100)/K63
006267E 1140. JR=(J2*100)/J1
006272B 1141. JR1=(J12*100)/J11
006276E 1142. JR2=(J14*100)/J13
006301J 1143. JR3=(J16*100)/J15
006305B 1144. JR4=(J18*100)/J17
006310L 1145. JR5=(J20*100)/J19
006314J 1146. JR6=(J22*100)/J21
006317B 1147. JR7=(J24*100)/J23
006323B 1148. JR8=(J26*100)/J25
006326J 1149. JR9=(J28*100)/J27
006332B 1150. JR10=(J30*100)/J29
006335B 1151. JR11=(J32*100)/J31
006341B 1152. JR12=(J34*100)/J33
006344B 1153. JR13=(J36*100)/J35
006350E 1154. JR14=(J38*100)/J37
006353B 1155. JR15=(J40*100)/J39
006357B 1155. JR16=(J42*100)/J41
006362J 1157. JR17=(J44*100)/J43
006366B 1158. JR18=(J46*100)/J45
006371E 1159. JR19=(J48*100)/J47
006375J 1160. JR20=(J50*100)/J49
006400B 1161. JR21=(J52*100)/J51
006404J 1162. JR22=(J54*100)/J53
006407E 1163. JR23=(J56*100)/J55
006413J 1164. JR24=(J58*100)/J57
006416B 1165. JR25=(J60*100)/J59
006422E 1166. JR26=(J62*100)/J61
006425J 1167. JR27=(J64*100)/J63
006431J 1168. NQ=((100)*(N2+M2+L2+K2+J2))/N
006440E 1169. SUM=X+Y+Z+V+U
006445B 1170. LL1=(100*(N18+M18+L18+K18+J18))/(N17+M17+L17+K17+J17)
006460B 1171. LL2=(100*(N26+M26+L26+K26+J26))/(N25+M25+L25+K25+J25)
006474J 1172. LL3=(100*(N34+M34+L34+K34+J34))/(N33+M33+L33+K33+J33)
006510B 1173. LL4=(100*(N42+M42+L42+K42+J42))/(N41+M41+L41+K41+J41)
006524B 1174. LL5=(100*(N50+M50+L50+K50+J50))/(N49+M49+L49+K49+J49)
006540E 1175. LL6=(100*(N58+M58+L58+K58+J58))/(N57+M57+L57+K57+J57)
006554B 1176. PRINT 827,SUM
006562J 1177. 827 FORMAT (//,*,THE TOTAL PENALTY PAID THIS YEAR IS *,F8.2)
006562B 1178. PRINT 801,N
006567B 1179. 801 FORMAT (//,*,5X,*,THE TOTAL NUMBER OF CONTRACTS IS*,2X,I3)
006567B 1180. PRINT 828,NQ
006574B 1181. 828 FORMAT (//,*,THE PERCENTAGE OF CONTRACTS IN WHICH PENALTIES WERE P
      CAID THIS YEAR IS*,2X,I3)
006574B 1182. PRINT 802,N1,NR
006602B 1183. 802 FORMAT (1*,5X,*,THE TOTAL NUMBER OF ROAD CONTRACTS FOR THE YEAR
      C1S*,2X,I3,/,5X,*,PERCENT OF ROAD CONTRACTS IN WHICH PENALTIES WERE
      CPAID IS*,2X,I3)
006602B 1184. PRINT 803,NR1,NR2,NR3
006611B 1185. 803 FORMAT (//,*,5X,*,PERCENT OF CITY ROAD CONTRACTS IN WHICH PENALTIES

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0070446 1200. C PENALTY FOR STATE BRIDGE CONTRACTS IS#,2X,F8.2)
PRINT 811,Y5,Y9,Y13,Y17,Y21,Y25,Y6,Y10,Y14,Y18,Y22,Y26,Y7,Y11,
CY15,Y19,Y23,Y27
0070728 1201. 811 FORMAT (////,28X,#PENALTY AMOUNTS#,,,22X,#01#,7X,#02#,6X,#03#,8X,
C#D4#,6X,#05#,8X,#06#,/,# BRIDGE*CITY#,6X,F8.2,X,F8.2,X,F8.2,X,
CF8.2,X,F8.2,X,F8.2,/,# BRIDGE*COUNTY#,4X,F8.2,X,F8.2,X,F8.2,X,
CF8.2,X,F8.2,X,F8.2,/,# BRIDGE*STATE#,5X,F8.2,X,F8.2,X,F8.2,X,
CF8.2,X,F8.2,X,F8.2)
PRINT 812, L1,LR
0070720 1202. 812 FORMAT ( #1#,5X,#THE TOTAL NUMBER OF ROAD*TRAFFIC CONTRACTS FOR TH
0071006 1203. CE YEAR IS#,2X,I3,/,5X,#PERCENT OF ROAD*TRAFFIC CONTRACTS IN WHICH
CPENALTIES WERE PAID IS#,2X,I3)
PRINT 813,LR1,LR2,LR3
0071006 1204. 813 FORMAT (////,5X,#PERCENT OF CITY ROAD*TRAFFIC CONTRACTS IN WHICH P
0071076 1205. CENALTIES WERE PAID IS#,2X,I3,/,5X,#PERCENT OF COUNTY ROAD*TRAFFIC
CCONTRACTS IN WHICH PENALTIES WERE PAID IS#,2X,I3,/,5X,#PERCENT OF
CSTATE ROAD*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS#,2X,
I3)
PRINT 814,L17,L25,L33,L41,L49,L57,LR4,LR8,LR12,LR16,LR20,LR24,
CL19,L27,L35,L43,L51,L59,LR5,LR9,LR13,LR17,LR21,LR25,L21,L29,
CL37,L45,L53,L61,L66,LR10,LR14,LR18,LR22,LR26,L23,L31,L39,L47,
CL55,L63,LR7,LR11,LR15,LR19,LR23,LR27
0071736 1207. 814 FORMAT (////,18X,#ROAD TRAFFIC CONTRACTS FOR THE DISTRICTS#,,,29X
C,#01#,7X,#02#,7X,#03#,7X,#04#,7X,#05#,7X,#06#,/,# TOTAL NUMBER#,15
CX,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT WITH PENALTIES#,5X,
CI3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH CITY EGR#,7X,I3,6
CX,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY*COUNTY EGR#,3X,I3,6
CX,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH COUNTY EGR#,5X,I3,6X,
CI3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY*COUNTY EGR#,1X,I3,6
CX,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH STATE EGR#,6X,I3,6X,I
CI3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY*STATE EGR#,2X,I3,6X,
CI3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3)
PRINT 815,Z,Z1,Z2,Z3
0071736 1208. 815 FORMAT (////,5X,#TOTAL PENALTY FOR ROAD*TRAFFIC CONTRACTS IS#,2X,F
0072036 1209. C8.2,/,5X,#TOTAL PENALTY FOR CITY ROAD*TRAFFIC CONTRACTS IS#,2X,F8.
C2,/,5X,#TOTAL PENALTY FOR COUNTY ROAD*TRAFFIC CONTRACTS IS#,2X,F8.
C2,/,5X,#TOTAL PENALTY FOR STATE ROAD*TRAFFIC CONTRACTS IS#,2X,F8.2
C)
PRINT 816,Z5,Z9,Z13,Z17,Z21,Z25,Z6,Z10,Z14,Z18,Z22,Z26,Z7,Z11,
CZ15,Z19,Z23,Z27
0072036 1210. 816 FORMAT (////,28X,#PENALTY AMOUNTS#,,,27X,#01#,8X,#02#,8X,#03#,5X,
C#D4#,8X,#05#,8X,#06#,/,# ROAD*TRAFFIC*CITY#,5X,F8.2,X,F8.2,X,F8.2,
CX,F8.2,X,F8.2,X,F8.2,/,# ROAD*TRAFFIC*COUNTY#,4X,F8.2,X,F8.2,X,F8.
C.2,X,F8.2,X,F8.2,X,F8.2,/,# ROAD*TRAFFIC*STATE#,5X,F8.2,X,F8.2,X,
CF8.2,X,F8.2,X,F8.2,X,F8.2)
PRINT 817,K1,KR
0072318 1212. 817 FORMAT ( #1#,5X,#THE TOTAL NUMBER OF ROAD*SURFACING CONTRACTS FOR
0072376 1213. THE YEAR IS#,2X,I3,/,5X,#PERCENT OF ROAD*SURFACING CONTRACTS IN WH
CICH PENALTIES WERE PAID IS#,2X,I3)
PRINT 818,KR1,KR2,KR3
0072376 1214. 818 FORMAT (////,5X,#PERCENT OF CITY ROAD*SURFACING CONTRACTS IN WHICH
0072466 1215. C PENALTIES WERE PAID IS#,2X,I3,/,5X,#PERCENT OF COUNTY ROAD*SURFAC
CING CONTRACTS IN WHICH PENALTIES WERE PAID IS#,2X,I3,/,5X,#PERCENT
C OF STATE ROAD*SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS
C#,2X,I3)
PRINT 819,K17,K25,K33,K41,K49,K57,KR4,KR8,KR12,KR16,KR20,KR24,
CX19,K27,K35,K43,K51,K59,KR5,KR9,KR13,KR17,KR21,KR25,K21,K23,
CX37,K45,K53,K61,K66,KR10,KR14,KR18,KR22,KR26,K23,K31,K39,K47,

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                                C8.2,X,F8.2,X,F8.2,X,F8.2,/,/,# ROAD*MAINTENANCE*COUNTY#,X,F8.2,X,F
                                C8.2,X,F8.2,X,F8.2,X,F8.2,X,F8.2,/,/,# ROAD*MAINTENANCE*STATE#,5X,F8
                                C.2,X,F8.2,X,F8.2,X,F3.2,X,F8.2X,F8.2)
                                PRINT 829,LL1,LL2,LL3,LL4,LL5,LL6
0075276      1232.
0075415      1233.      829 FORMAT (1#,5X,#OVERALL PENALTY PERCENTAGE BREAKDOWN BY DISTRICTS
                                C#,/,5X,#D1#,5X,#D2#,5X,#D3#,5X,#D4#,5X,#D5#,5X,#D6#,/,4X,I3,4X,I3
                                C,4X,I3,4X,I3,4X,I3,4X,I3)
                                STOP
0075416      1234.
007543E      1235.      END
                                C* * * * *
                                C
                                C* * * * * ANALYSIS FOR 1975
                                C* * * * *

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Appendix B

Appendix B

COMPUTER PROGRAM OUTPUT

CONTRACTS WITH PENALTIES	PENALTY AMOUNT
R*08744	1231.53
R*08937	1979.34
R*08955	712.25
R*09060	287.04
R*09209	74.12
R*09440	274.23
R*09553	314.46
R*09581	65.60
R*09586	610.46
R*09621	70.03
R*09732	794.02
R*09831	372.08
R*09875	380.60
R*09878	381.29
R*09879	43.78
R*09906	55.16
R*09930	62.02
R*10092	181.64
R*10198	129.81
R*10246	22.43
R*09543	532.09
R*09568	1068.71
R*09427	822.22
R*09357	95.30
R*10127	19.84
R*09888	138.49
R*09880	162.21
R*09356	166.69
R*10090	22.06
R*09971	24.28

R*09762	24.82
R*09766	196.18
R*09505	699.68
B*09912	24.72
B*09514	327.18
B*09820	39.71
B*08840	49.69
B*09941	34.04
B*10131	154.18
B*09925	53.63
B*09750	879.43
B*09486	72.07
B*09377	12.82
B*08836	360.55
B*08877	6245.05
B*09954	23.09
B*09488	22.23
B*09425	275.14
B*09866	97.22
B*09755	376.93
B*09658	17.29
B*09660	38.27
RT*09897	15.60
RT*10163	19.88
RT*09695	403.23
TX*09433	1896.96
TX*09432	2536.52
TX*09367	1474.72
TX*09074	773.51
RT*10239	26.20

RT*09841	69.81
RT*09834	1589.00
RT*09833	684.90
RS*10055	15.10
RS*10056	26.14
RS*09990	42.77
RS*09992	25.75
RS*10175	12.30
RS*10047	328.40
RS*09982	56.73
RS*10044	665.24
RS*09807	149.38
RM*10038	271.89
RM*10039	47.45
RM*10037	22.73

THE TOTAL PENALTY PAID THIS YEAR IS \$32272.57

THE TOTAL NUMBER OF CONTRACTS IS 355

THE PERCENTAGE OF CONTRACTS IN WHICH PENALTIES WERE PAID THIS YEAR IS 21

THE TOTAL NUMBER OF ROAD CONTRACTS FOR THE YEAR IS 34
 PERCENT OF ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 35

PERCENT OF CITY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 34
 PERCENT OF COUNTY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 33
 PERCENT OF STATE ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 32

ROAD CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	13	15	13	14	22	17
PERCENT WITH PENALTIES	38	26	69	21	31	29
NUMBER WITH CITY EGR	1	4	2	3	1	0
PERCENT PENALTY*CITY EGR	100	50	100	33	0	0
NUMBER WITH COUNTY EGR	0	1	1	0	1	0
PERCENT PENALTY*COUNTY EGR	0	0	100	0	0	0
NUMBER WITH STATE EGR	12	10	10	11	20	17
PERCENT PENALTY*STATE EGR	33	20	60	18	35	29

TOTAL PENALTY FOR ROAD CONTRACTS IS 12014.46
 TOTAL PENALTY FOR CITY ROAD CONTRACTS IS 1511.29
 TOTAL PENALTY FOR COUNTY ROAD CONTRACTS IS 55.16
 TOTAL PENALTY FOR STATE ROAD CONTRACTS IS 10448.01

PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD*CITY	22.06	300.70	1166.10	22.43	0	0
ROAD*COUNTY	0	0	55.16	0	0	0
ROAD*STATE	944.96	146.53	2943.39	561.27	4517.27	1294.59

THE TOTAL NUMBER OF BRIDGE CONTRACTS FOR THE YEAR IS 107
 PERCENT OF BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 17

PERCENT OF CITY BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 0
 PERCENT OF COUNTY BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 21
 PERCENT OF STATE BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 17

BRIDGE CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	11	24	15	23	17	17
PERCENT WITH PENALTIES	36	12	46	4	11	11
NUMBER WITH CITY EGR	0	0	0	0	0	0
PERCENT PENALTY*CITY EGR	0	0	0	0	0	0
NUMBER WITH COUNTY EGR	5	5	1	1	5	2
PERCENT PENALTY*COUNTY EGR	40	20	100	0	0	0
NUMBER WITH STATE EGR	6	19	14	22	12	15
PERCENT PENALTY*STATE EGR	33	10	42	4	16	13

TOTAL PENALTY FOR BRIDGE CONTRACTS IS 9103.24
 TOTAL PENALTY FOR CITY BRIDGE CONTRACTS IS 0
 TOTAL PENALTY FOR COUNTY BRIDGE CONTRACTS IS 229.79
 TOTAL PENALTY FOR STATE BRIDGE CONTRACTS IS 8873.45

PENALTY AMOUNTS

	01	02	03	04	05	06
BRIDGE*CITY	0	0	0	0	0	0
BRIDGE*COUNTY	135.49	22.23	72.07	0	0	0
BRIDGE*STATE	394.22	298.23	7705.66	34.04	89.40	351.90

THE TOTAL NUMBER OF ROAD*TRAFFIC CONTRACTS FOR THE YEAR IS 35
 PERCENT OF ROAD*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 30

PERCENT OF CITY ROAD*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 72
 PERCENT OF COUNTY ROAD*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 0
 PERCENT OF STATE ROAD*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 12

ROAD*TRAFFIC CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	4	3	12	8	4	5
PERCENT WITH PENALTIES	25	100	50	12	0	0
NUMBER WITH CITY EGR	2	2	4	2	1	0
PERCENT PENALTY*CITY EGR	50	100	100	50	0	0
NUMBER WITH COUNTY EGR	0	0	0	0	0	0
PERCENT PENALTY*COUNTY EGR	0	0	0	0	0	0
NUMBER WITH STATE EGR	2	1	8	6	3	5
PERCENT PENALTY*STATE EGR	0	100	25	0	0	0

TOTAL PENALTY FOR ROAD*TRAFFIC CONTRACTS IS 9490.33
 TOTAL PENALTY FOR CITY ROAD*TRAFFIC CONTRACTS IS 7547.23
 TOTAL PENALTY FOR COUNTY ROAD*TRAFFIC CONTRACTS IS 0
 TOTAL PENALTY FOR STATE ROAD*TRAFFIC CONTRACTS IS 1943.04

PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD*TRAFFIC*CITY	684.90	1658.81	5187.98	15.60	0	0
ROAD*TRAFFIC*COUNTY	0	0	0	0	0	0
ROAD*TRAFFIC*STATE	0	26.20	1916.84	0	0	0

THE TOTAL NUMBER OF ROAD*SURFACING CONTRACTS FOR THE YEAR IS 75
 PERCENT OF ROAD*SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 11

PERCENT OF CITY ROAD*SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 0
 PERCENT OF COUNTY ROAD*SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 0
 PERCENT OF STATE ROAD*SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 11

ROAD*SURFACING CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	13	12	8	13	14	16
PERCENT WITH PENALTIES	15	25	0	23	7	0
NUMBER WITH CITY EGR	0	0	0	0	0	0
PERCENT PENALTY*CITY EGR	0	0	0	0	0	0
NUMBER WITH COUNTY*EGR	0	0	0	0	0	0
PERCENT PENALTY*COUNTY EGR	0	0	0	0	0	0
NUMBER WITH STATE EGR	13	12	8	13	14	16
PERCENT PENALTY*STATE EGR	15	25	0	23	7	0

TOTAL PENALTY FOR ROAD*SURFACING CONTRACTS IS 1322.47
 TOTAL PENALTY FOR CITY ROAD*SURFACING CONTRACTS IS 0
 TOTAL PENALTY FOR COUNTY ROAD*SURFACING CONTRACTS IS 0
 TOTAL PENALTY FOR STATE ROAD*SURFACING CONTRACTS IS 1322.47

PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD*SURFACING*CITY	0	0	0	0	0	0
ROAD*SURFACING*COUNTY	0	0	0	0	0	0
ROAD*SURFACING*STATE	814.62	398.03	0	94.66	15.16	0

THE TOTAL NUMBER OF ROAD*MAINTENANCE CONTRACTS FOR THE YEAR IS 42
 PERCENT OF ROAD*MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 7

PERCENT OF CITY ROAD*MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 0
 PERCENT OF COUNTY ROAD*MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 0
 PERCENT OF STATE ROAD*MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 7

ROAD*MAINTENANCE CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	2	6	9	7	8	10
PERCENT WITH PENALTIES	0	16	22	0	0	0
NUMBER WITH CITY EGR	0	0	4	0	0	0
PERCENT PENALTY*CITY EGR	0	0	0	0	0	0
NUMBER WITH COUNTY EGR	0	0	0	0	0	0
PERCENT PENALTY*COUNTY EGR	0	0	0	0	0	0
NUMBER WITH STATE EGR	2	6	9	7	8	10
PERCENT PENALTY*STATE EGR	0	16	22	0	0	0

TOTAL PENALTY FOR ROAD*MAINTENANCE CONTRACTS IS 342.07
 TOTAL PENALTY FOR CITY ROAD*MAINTENANCE CONTRACTS IS 0
 TOTAL PENALTY FOR COUNTY ROAD*MAINTENANCE CONTRACTS IS 0
 TOTAL PENALTY FOR STATE ROAD*MAINTENANCE CONTRACTS IS 342.07

PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD*MAINTENANCE*CITY	0	0	0	0	0	0
ROAD*MAINTENANCE*COUNTY	0	0	0	0	0	0
ROAD*MAINTENANCE*STATE	0	22.73	319.34	0	0	0

OVERALL PENALTY PERCENTAGE BREAKDOWN BY DISTRICTS

01	02	03	04	05	06
27	23	42	12	15	10

Appendix C

ERRATA SHEETS FOR THE INDIANA STATE HIGHWAY COMMISSION 1970 CONSTRUCTION
RECORD GUIDE FOR ROAD, BRIDGE, MAINTENANCE, AND TRAFFIC CONTRACTS

Explanation Sheet 1b	Quantity in the first paragraph is misspelled.
Page 1-1	In the volume of cut column, the 118 should be 119.
Page 1A-1	In the % deviation column, the 0 for Station 7 should be +1. The algebraic total should be +13. The average should be +1.
Page 1A-2	The quantity on plans should be 98766. The difference should be -129.
Page 3	The quantity placed should be 20243. The overrun quantity should be 4846. The overrun cost should be \$2907.60.
Page 3-1	The sum of end areas for stations 33+00 and 33+50 should be 1871. The volume of cut for these stations should be 1732. The total cut should be 20243.
Explanation Sheet 6a	In the second paragraph, if in the last line is misspelled.
Page 6	For structure number 16, the remarks column should read "See p. 70."
Page 6-1	On the bottom drawing, the 4.5' measurement should be 3.0'. A new dimension should be added to show 1.5' of cover. Beside the bottom drawing, both lines should read "from table 006."
Page 6-2	The line below the drawing should read "From Table 003."

- Page 7-1 In the summary, the curb and gutter removal should be item 9. In the heading, the contract number should be I-0000 and the item number should be 7 & 9.
- Page 11-1 For day 19, the lineal feet laid should be 1060. For day 22, the lineal feet laid should be 700.
- Page 14-1 For day 17, the lineal feet laid should be 5100. For day 18, the lineal feet laid should be 5100. For day 29, the lineal feet laid should be 10200.
- Page 16-1 For the first course, the lineal feet laid should be 1530. This is also true for the second and third courses.
- Page 17-2 The top 10 feet of the sketch should be labeled H.
- Page 28-2 Between stations 50+00 and 52+80, the average depth should be 4.25.
- Page 31-1 The bottom toewall calculation should total to 122.8. The sum of the toewall areas will then be 148.8. The grand total area above the summary block should be 380.8.
- Page 41-1 In both road portion calculations, the weight should be 2237 and not 2230.
- Page 53-2 The total of the length put in leads column should be 314.1.
- Page 59 The last line should read "on I.C. 626 on p. 73."
- Page 61 After the last line, add "Addition approved on I.C. 626 on p. 73."
- Page 62 In the second to the last line, maintenance is misspelled.
- Page 63-3 The peat excavation unit price should be \$0.60. The peat excavation quantity increase should be 4846.

Page 63-3 cont'd.

The peat excavation amount increase should be \$2907.60.

The peat excavation % change should be +31%.

The total amount increase should be \$68615.00.

The total estimated cost should be \$15242.00.

In the top paragraph, the fourth line should read "sheet 63-4."

Page 63-4

For peat excavation, the final quantity should be 20243.

For peat excavation, the overrun should be 4846.

Page 65-1

The % of change for item 17 should be -9%.

Page 65-2

In the middle of the page, the statement should read "To pps. 17-1 & 65-1."

Page 66

The specification article referred to should be 715.12.

Page 66-1

The specification article referred to should be 715.12.

Page 70

For structure 14, the error in plan quantity should be +30.

For structure 14, the net change regular portion should be +23.

Item 6 quantity increase should be 23.

Item 6 amount increase should be \$92.00.

Total increase amount should be \$92.00.

The estimated cost should be \$28.00.

Page 71

The first line in the second paragraph should read "on sheet 10-3."

At the bottom of the table, does and decreased should be marked out.

Page 72

The last line of the paragraph should read "Extra Work Agreement on p. 67-1."

Page 74

For item 3, the final estimate quantity should be 20243.

For item 3, the final estimate amount should be \$12145.80.

For item 3, the overrun quantity should be 4846.

For item 3, the overrun amount should be \$2907.60.

Page 77

The final estimate amount should be \$475911.79.

The overrun amount should be \$86157.84.

The net overrun should be \$22478.29.

The net overrun percentage should be 4.957%.

Page 78

For item 3, the final estimate quantity should be 20243.

For item 3, the final estimate amount should be \$12145.80.

For item 3, the overrun quantity should be 4846.

For item 3, the overrun amount should be \$2907.60.

Page 80

The total original estimate amount should be \$405541.85.

The total final estimate amount should be \$425947.74.

The overrun total amount should be \$83361.44.

The net overrun should be \$20405.89.

The net overrun percentage should be 5.032%.

Table 107

For $D=1.8$, $V=0.0659$.

Index

Accuracy misspelled on lines 3 and 4 of the first page.

Surface misspelled on line 20 of the first page.

Theoretical misspelled on lines 22 and 23 of the third page.

COVER DESIGN BY ALDO GIORGINI